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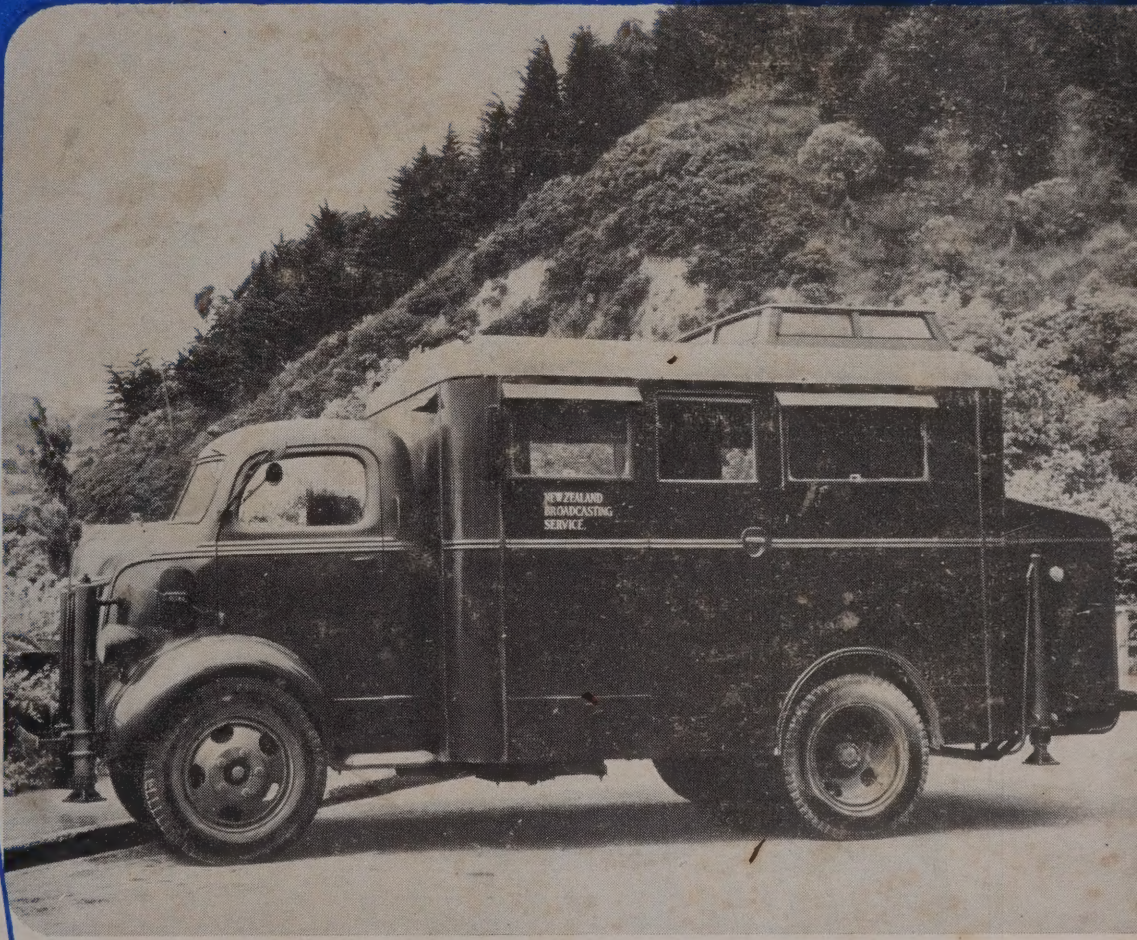

In this Issue: Some Points About Long-playing Records.

FEBRUARY 1st, 1952 VOL. 6, NO. 12

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RADIO AND ELECTRONICS

Vol. 6, No. 12 1st February, 1952

Page

OUR COVER

This month shows the new recording van designed and built by the New Zealand Broadcasting Service for use during the forthcoming Royal tour.

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Why Not V.H.F. Broadcasting For New Zealand ?

It is becoming increasingly apparent that from now on, it will be difficult to provide better broadcast reception for those who are poorly served by the existing chain of broadcasting stations. In the last few years, the New Zealand Broadcasting Service has made strenuous and commendable efforts to provide better coverage for the not inconsiderable number of listeners who did not get first-class reception from the main high-powered stations. However successful these efforts may have been, there must still be areas of the country in which a first-class service cannot be obtained, so that there must still be scope for improvement.

It is interesting to note that in the United Kingdom, a somewhat similar situation exists, but in an aggarvated form. Here, the chief difficulty lies in our extraordinary topography, which makes nation-wide coverage by transmissions on the broadcast band a very difficult thing to attain. At the same time, we are plagued by the laws of Nature, in so far as they affect the propagation of broadcast band transmissions over water. That is to say, at night, both we and the Australians suffer from mutual interference, owing to the extremely good propagation that takes place over the Tasman Sea. We need sensitive receivers, in order to cope with the poor propagation over our own land masses, but these same receivers pick up very well Australian transmissions on the same channels as some of our own. Few people these days are not aware of the heterodyne interference from Australian broadcast stations, that ruin reception of our own more distant ones, even though they are providing a perfectly adequate signal strength. This fact has been recognized by the authorities both here and in Australia, who have conducted discussions, and come to agreements touching the allocations of frequencies to sations in both countries. This is the reason for the frequency alterations which annoyed everybody so much not very long ago.

In Great Britain, the coverage problem is not so acute, topograpically, but the difficulties caused by the proximity of the high-powered stations on the Continent are even greater than the similar ones encountered here. As a result, it is not possible for the B.B.C. to go on adding low-powered stations to give coverage to difficult areas, because even these would be almost impossible to fit into the present frequency-allocation scheme. As a result, the B.B.C. have decided that the answer, as far as they are concerned, is to provide an alternative service on the very high frequencies. The question of whether A.M. or F.M. shall be used for this new service is one that has not been decided yet, but in either case, the V.H.F. broadcasts will make it possible, as a sort of by-product, for listeners to have high-fidelity reception should they desire it. For this reason, there are probably many who would like to see the whole country covered by the new transmissions.

It does not seem impossible that a V.H.F. broadcasting chain, operating in paralel, as it were, with the normal M.F. transmissions, would be the answer to our own coverage problem. The Civil Aviation authorities have recently announced that the whole of their aircraft communication system will be changed over to V.H.F., and that this can be done using only a very few ground transmitters to cover the whole of New Zealand. Admittedly, the situation is rather different in the case of aircraft, since they and their receivers are most of the time at a great height, but for serving even large areas without causing long-range interference, it should be possible to usefully employ V.H.F. For small isolated communities, whose broadcast band reception from none of our own stations is good, a very low-powered unattended V.H.F. transmitter could provide a programme "piped" from some spot where good reception of one of the main stations can be obtained, or brought to it by land-line. There are instances where isolated communities (not in this country) have themselves provided broadcast reception by similar, if not identical means.

If such a scheme were put into operation, there would be no reason for limiting the V.H.F. transmission to a single programme. One can envisage a system like the following: At the nearest place where broadcast band reception is good, a receiving site is set up, and a broadband receiver is employed which accepts and amplifies the whole broadcast band simultaneously. This band is then modulated upon a V.H.F. carrier and transmitted in the required area. Listeners in that area are provided each with a broad-band converter whose output consists of the broadcast stations' signals, on their proper frequencies. The signals are then selected in the ordinary way by the listener, by tuning his receiver.

It would be a simple matter to modify this scheme so as to provide only the signals from certain selected sations, and this might be desirable where only one or two can be received well at the master receiving site.

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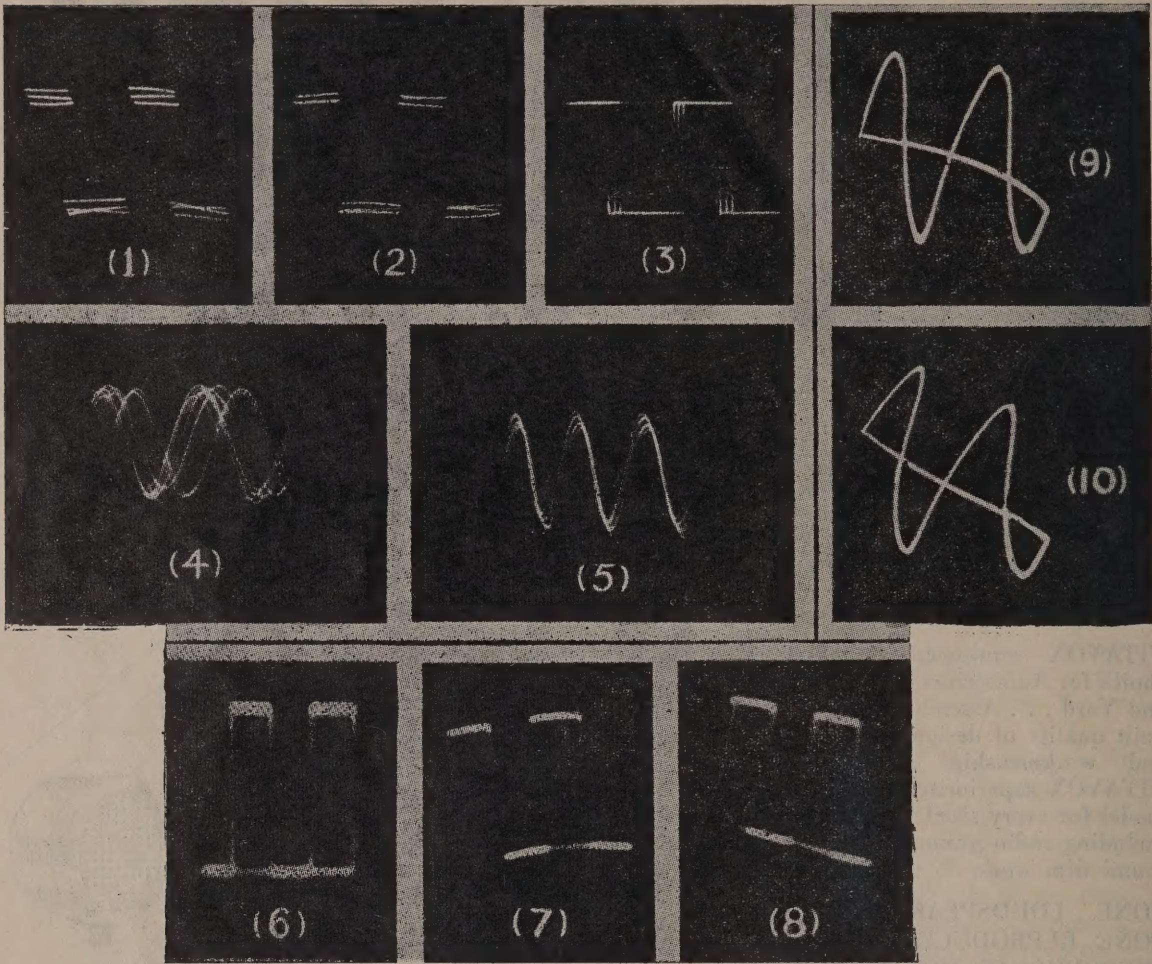
Distortion of 'Scope Traces

By JOHN F. RIDER



Every so often conditions of operation result in distorted test oscilloscope traces, interfering with the application of the 'scope and proper interpretation of the pattern.

When this happens, it is not necessarily because anything is wrong with the equipment being checked, or with the test oscilloscope; quite often the difficulty lies in the physical arrangement of the test set-up and the behaviour of some of the equipment.

It therefore becomes necessary to recognize the possible origin of the distortion by proper interpretation of the trace. Included here are several 'scope patterns extant under certain conditions of test. In each instance the remedy is simple, but unless the cause is known, the cure cannot be effected.

All 'scopes are contained inside metal cabinets. The cathode-ray tube is usually mounted within a high permeability metal shield to protect the electron beam from external fields. This arrangement is effective, but at times not sufficiently so to keep the trace free from external influences.

It is quite natural for current-carrying transformers to be in the proximity of a test set-up. These may vary from small to large voltage regulating units, and can cause surprisingly strong fields which will materially effect the electron beam inside the 'scope.

Patterns 1, 2, and 3 show the effects of a transformer carrying several amperes of current which was located near a cathode-ray 'scope while tests were being made on square waves. Pattern 1 shows the effect of the external field when the transformer was located on top of the 'scope cabinet. Pattern 2 shows the effect when the transformer was located adjacent to the 'scope cabinet, all other conditions remaining the same. (Both of these locations for auxiliary equipment are commonplace when bench space is not too plentiful.) When the transformer

in the latter instance was rotated by 90 deg. the trace shown in Pattern 3 resulted.

The A.C. field issuing from the transformer resulted in the multiple traces of Patterns 1 and 2, with evident vertical displacement. In addition, the sinusoidal nature of the current responsible for the field caused the curvature in the flat portions of these traces. In the case of Pattern 3 a multiple trace also occurred, but was not very obvious because in this instance the displacement was horizontal. The horizontal traces overlap each other and therefore can only be detected by careful observation of the retraces of the square wave in this pattern. (The traces appearing in Pattern 3 have been made more obvious by retouching.)

Similar effects displayed on a sine wave trace are shown in Patterns 4 and 5. In the former the displacement is in the horizontal direction, in the latter, in the vertical.

Pattern 6 is a reference pattern for a square wave. (Excessive exposure thickened the trace.) Pattern 7 shows distortion in this trace when subjected to a very strong, steady magnetic field issuing from a powerful permanent magnet (that of a magnetron assembly) which happened to be in front of the tube screen. Pattern 8 is the effect of the same magnet moved to one side of the cabinet housing. The extent of the tilt in Patterns 7 and 8, and the direction of the tilt, is a function of the intensity of the external interfering field and its direction.

The effects of similar interfering field conditions on a sine wave trace are shown in Patterns 9 and 10.

The solution in each case is simple: removal of the source of the interfering field. Sometimes the interference of the external field can be minimized by reorientation,

(Continued on Page 48.)

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Outside Broadcasts from Almost Anywhere

THE N.Z.B.S. BUILDS AN ULTRA-MODERN RECORDING VAN

A few days ago, *Radio and Electronics* had the privilege of examining the latest mobile recording van to be put into service by the New Zealand Broadcasting Service. This van, a picture of which is featured on this month's front cover, is the outcome of several years experience in operating field equipment for the recording of on-the-spot programmes, and embodies several novel features.

TAPE RECORDING USED

Perhaps the most radical departure from previous practice in this field is the use of tape recorders instead of disk machines. Ever since high-quality tape recording has been an accomplished fact, the use of tape has brought to broadcasters a number of very considerable advantages over the best previously available recording medium, acetate direct-playback disk recording. It is true that the latter has been brought to a very high pitch of perfection of recent years, but the fact remains that not only is tape recording capable of even higher reproduced quality than the best disk recording, but also that it is very much easier to do within the reasonable certainty that all the recordings made will be of the same high standard. Disk recording is at the very best a difficult and tricky process, especially if the most excellent results are continuously required, while the latest tape machines have exceedingly few operational difficulties attached to them. In consequence, they are ideal for operation under field conditions, when repair and test facilities are always at a minimum, and when not only breakdowns, but even slight deteriorations in quality must be avoided at all costs.

The mobile recording van, we were told, is to be used during the forthcoming Royal Tour as a source of programme material from places where broadcast facilities are not directly available, or where re-broadcasting from, say, one of the smaller stations would not be very satisfactory as a means of giving national coverage to the important events taking place.

Then again, apart from quality and ease of operation, tape recording has the inestimable advantage that editing of the recorded material is not only possible, but is very readily accomplished. One cannot cut a recording made on a disk, and join up the bits again, but with tape this is very easily done; when pieces have been excised in this manner, or other pieces inserted, as when it is desired to add a commentary not recorded at the same time as the event itself, this can be done without any audible effect at all. Tape can be cut and joined without producing the slightest trace in the reproduction that this has been done.

The basis of the van's equipment, then, is a pair of E.M.I. professional tape recorders, which run at the high speed of 30 inches per second, enabling recordings to have a frequency response up to 15,000 c/sec. and over. Means are provided (and this cannot satisfactorily be accomplished with disk machines) for automatically starting up the second machine when the tape on the first is almost exhausted. In this way, it is possible for a single operator to record continuously for as long as may be necessary, without any breaks in the continuity. Normally, of course, the equipment would be handled by two men, one at the controls, and the other looking after the recorders.

Another advantage of tape recorders for mobile work is that the audio power required is very small compared with disk recording, so that the associated amplifying equipment is considerably lighter and less complicated. This is a great aid to achieving perfect reliability.

THE AUDIO EQUIPMENT

In order that the mobile recording unit shall be able to cope with even the most complex situations, provision has been made for six microphones, all of which can be in use simultaneously if necessary. The audio equipment thus consists of a large enough number of pre-amplifiers, and a mixing panel capable of accommodating all these, with the additional facility of being able to take in the output of a radio receiver which is part of the van's equipment. After the mixing circuit come line amplifiers and monitor amplifiers which enable the programmes to be sent off, say, to a nearby transmitter at the same time as it is being recorded. The van is thus able to act as a direct outside-broadcast unit as well as a recording unit.

Considerable pains have been taken to ensure that the essential equipment is as accessible as possible, so that maintenance or field repair work can be carried out with the least possible difficulty and delay. For example, the control console is hinged in such a way that the whole unit can be swung forwards and downwards, exposing the circuits completely for such purposes as replacing valves or other components, and cleaning of the faders.

Similar principles have been applied to the other electronic equipment, which is housed in a small rack, built into a compartment at one side of the operating position. In addition to the remote microphones, provision is made for a microphone position in the cab of the van, so that a commentator can work from the van itself. The cab is therefore provided as well with a monitor speaker and a hand telephone set which communicates with the operating position in the body of the van.

The most noticeable thing about the design of the equipment, and the van's facilities is that no pains have been spared to make the job of those responsible for operating it as easy as possible, and to this end, the attention to apparently small detail is rather surprising to the uninitiated. For example, tucked away in a special compartment are a number of lengths of stout wooden trough. The purpose of these is not at all obvious until it is explained that it is sometimes necessary for the cables from the microphones to the van to cross a road or other thoroughfare, and that in the past considerable difficulty has been experienced through mike cables becoming entangled with the under-portions of passing motor-cars. The troughs are designed to prevent mishaps of this nature by covering the cables as they cross the road!

In order to speed up the process of becoming operational once the van has arrived at the scene of the broadcast, several things have been done. The equipment is intended to operate only from 230 volts A.C., as its use in places where power is not available is not envisaged. A trailer, housing a diesel-electric generator can be used to power the van, though this will not be used during the Royal tour.

Thus, the first job on arrival at the site is to run out the A.C. cable and attach it to the nearest available outlet. Of course, such matters as the exact site, and the availability of a power outlet are a matter of prior organization, and the personnel will know in advance just what has to be done in this respect. The cable is wound on a free-wheeling drum at the back of the van, and can be reeled out without any delay, and with the minimum

of manhandling. In order to facilitate working at night, the van is provided with duplicate lighting supplies—12v. D.C. from a battery housed in the van, and 12v.5 A.C. from a transformer, which is brought into use as soon as the power is connected. The microphones are each provided with 500 feet of cable. This is wound on six drums, also housed at the back of the van. The drums can be driven by an electric motor together with a system of clutches, one for each drum, so that it is possible to be reeling in one drum at the same time as others as being reeled out. Guides have even been provided so that the cable from each drum can be pulled off in any direction without danger of its running off the drum to which it belongs, and so that reeling-in can be done at full speed irrespective of the directions in which the cables are lying. Each 500-foot cable is attached to the amplifying equipment inside the van through a plug and socket in the cable storage compartment. Among other things, this enables cables to be completely wound off the reels and connected in series should runs of over 500 feet be required.

Altogether, this is a remarkably efficient piece of equipment, designed for a specific job, and one of which the Broadcasting Service's Head Office Laboratory, and workshop, who designed, built, and installed the equipment, may well be proud. It shows, too, that contrary to some people's belief, the technical services in this country are far from backward in their use of modern equipment and ideas. From our own observation, the gear used and built by our own technicians has nothing to fear from comparison with any other equipment of a similar nature in the world, and this mobile recording van has once again amply demonstrated the fact.

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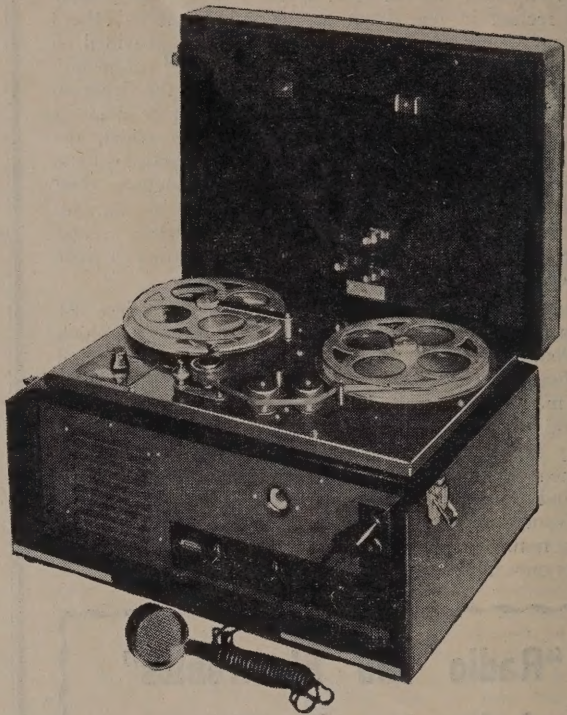
THE SIMPHONIC TAPE RECORDER



SPECIFICATIONS

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Some Points About Long-playing Records

Now that at long last, long-playing gramophone records have become available in this country, it would perhaps not be inappropriate to say something in these pages about them and their characteristics, and to give some idea of what record enthusiasts will have to do in order to get satisfactory results from them. In the first place, there appear to be several misconceptions about the new records, so that some precise technical data would probably be welcomed by many of our readers.

WHAT ARE L/P RECORDS?

One of the greatest handicaps under which conventional 78 r.p.m. gramophone records have laboured for so many years is that their playing-time is so short. It is true that for a number of purposes, a playing time of

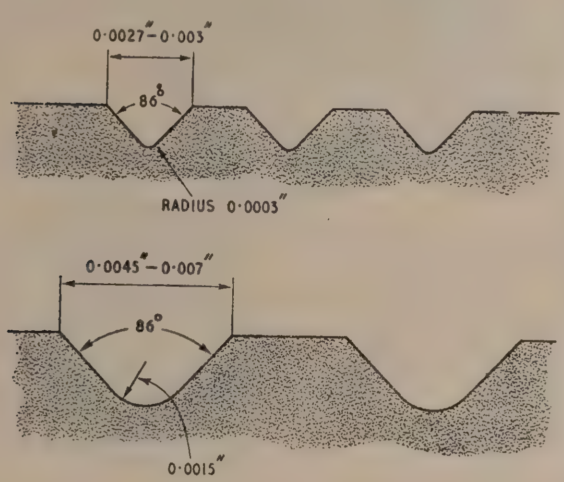

Fig. 1.—Diagram showing the exact dimensions of 78 and L/P recording grooves.

four minutes is ample, and indeed too long for some, as witness the extreme popularity of ordinary 10 in. disks for the recording of popular songs and dance music. In fact, it seems not unlikely that however much success the new L/P records achieve, there will always remain a need for ten- and twelve-inch records playing for three and four minutes respectively, or else for smaller disks, running at 33⅓ r.p.m., for shorter items, and for popular music of the kind where the buyer wants to purchase only one item at a time. It is in the field of more serious music, in which a single work may last up to 45 minutes or so, that L/P records seem at present to have their greatest advantages, and therefore the greatest appeal to the buyer. That is not to say that at some future date recording at 78 r.p.m. may become obsolete, a satisfactory method of presenting short items on 33⅓ r.p.m. disks having been developed. It is a matter for the future to decide, and at present, it seems that we will have "ordinary" and L/P records being produced, sold, and used side by side, for a number of years yet.

This brings us to our first point. The primary reason for the production of L/P records is the greatly increased playing time that is made available in a record of a given size. For instance, a 12 in. L/P record plays for approximately four times as long as a 12 in. 78 r.p.m. disk. That is to say, 16 minutes as against four for each side of the record, giving a total playing time for one L/P record of over half an hour. To those musically inclined, this is a very great improvement, for the majority of symphonies, concertos, sonatas, etc., can be accommodated within this period. Not only is this so, but in addition, the one break that is needed to enable the record to be turned over, hardly ever has to create a break in the music, since long works are usually divided into movements, between which, in an actual performance, there is more often than not a short break. As a result, the L/P record makes it possible for the music-lover to play his favourite works without having to hop up and down every four minutes, and without those exceedingly annoying breaks in the continuity that are inevitable with 78 r.p.m. recordings. Briefly, the L/P record provides an almost perfect answer to the problem which automatic record changers were designed to overcome. In spite of their drawbacks, record changers have become very popular—so popular, in fact, that they are now standard equipment on any radio-gramophones, with the sole exception of the lowest-priced varieties.

The solution provided by the changer is a very imperfect one, because it does nothing to prevent the breaks between records. All it can do is to eliminate the manual changing of records, and when a long work is to be played, they will not play it right through unless one possesses two sets of records, even when these are arranged in the so-called "automatic couplings." Yet in spite of this, automatic changers are being made which will play ordinary records, and L/P ones as well. This seems rather a ridiculous situation at first sight, but it really does cater for those who have already had automatic changers for 78, and who now want the added facility of being able to play 33⅓ records without employing an entirely separate turntable specially for the purpose. However, as more and more people use more and more L/P records, the necessity for automatic changers will gradually disappear, because there will in all probability be a tendency to make as many as possible of one's new records L/P ones, with the gradual elimination of 78s. Indeed, it will not be very long before the younger generation of record enthusiasts possess only L/P records. It is our guess that with the advent of the L/P record, the demand for changers will gradually decline, because there is certainly no necessity for a changer when only L/Ps are being played.

JUST HOW DO L/P RECORDS DIFFER FROM 78s?

When one looks at the technical specifications of L/P records the difference between them and the ordinary 78s is very marked indeed, and concern a number of things apart from the speed of rotation. If the only difference was the change in speed, the playing time of an L/P record would be only a little more than twice that of its counterpart. The fact that the ratio of playing time is more like four to one than two to one, indicates that something else must have been done as well. In point of fact, several things have been done. The material from which the record has been pressed has been changed, and this is responsible for a considerable improvement, in a direction not at all related to the play-

ing time. The grooves of the L/P record are much shallower, and also much narrower than those of the 78 disk, and for this reason, it is possible to put them much closer together. In L/P records, there are between 240 and 320 grooves to the inch, as against about 100 to the inch for a conventional record. Thus it is that the increase in playing time is brought about. In Fig. 1 are shown the essential dimensions of the grooves of the two types of recording. It will be noticed that the radius of the bottom of the larger groove is 0.0015 inches. Comparing this with the radius of the normal stylus used for 78 recordings, namely 0.0025 inches, it can be seen that the needle does not sit on the bottom of the groove, but makes contact on the straight sides of the groove, just up from the rounded bottom. The standard tip radius for a stylus designed for 33⅓ records is 0.001 inches, while the radius of the bottom of the groove is 0.0003 inches. Thus, the same conditions obtain with the L/P record as far as the position of the stylus in the groove is concerned.

The above emphasizes why it is essential for L/P records to be played with a special stylus, of much narrower tip radius than is used for ordinary records. Fig. 1 shows that the width of the L/P groove at the surface of the record is very little greater than the tip radius of a standard stylus, so that if an attempt is made to play an L/P record with a standard stylus, the result will not be very gratifying, since the stylus will either break down the walls of the L/P groove, or will skate wildly across the disk, refusing to stay in the groove.

At the same time, an L/P stylus will not play a 78 record satisfactorily because the 0.001 stylus will sit loosely in the bottom of the 78 groove, and will be able to slip from side to side inside the groove, without following its lateral movements properly. The result in this case would be buzzing, and distorted reproduction.

If modern gramophone pick-ups used replaceable styli, or "needles" as we used to call them, like the old steel needles, then it might be made a comparatively simple matter to use the same pick-up to play both kinds of record. However, there are a number of reasons why this approach is not practicable. First of all, the life of the recording must be considered. The L/P records are not made of the hard, abrasive, shellac mixture that was used for 78 recordings. Instead, they are made from one of some relatively soft and pliable plastic materials which go by the generic name of vinylite. These substances differ somewhat from one maker of records to another, and go under a number of different trade names. Some L/P records—notably some of those made in America, are made from cellulose nitrate, which is quite different from the vinylites in chemical composition, and which, incidentally, results in a very different frequency response. These comparatively soft materials prevent altogether, the use of heavy pick-up heads, if the records are to have a life of more than a few playings. Only modern light-weight pick-ups can be used successfully with L/P records, and all these pick-ups have built-in styli, that can usually be replaced only by replacing the whole armature unit. However, the user does not have to do this very often, because the styli used are semi-permanent, and last for over two thousand playings before deterioration due to wear on the stylus is noticeable. This is very convenient, but has the drawback that the same pick-up head cannot be used for playing both ordinary and L/P disks. A number of pick-up manufacturers have overcome this by making separate heads for ordinary and L/P records, and by designing the pick-up arm so that either head can be plugged into it. This has the further advantage that each head can have the weight that is necessary for the type of record it is designed to play. This is because in general, a pick-up needs to press a little more heavily on the record for 78 disks than for L/P ones. The majority of L/P heads put a weight of no more than one-third to one-half an ounce on the record. Any less, it has been found, makes very little difference as far as reduction of record wear is concerned, and also it is difficult to design a head that works satisfactorily with less weight than this.

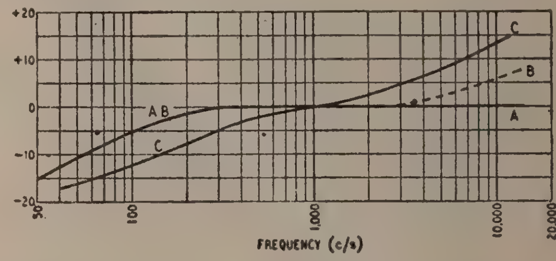

Fig. 2.—Frequency characteristic of (A) standard 78 recordings, (B) Decca ffrr 78 records, and (C) Decca L/P recordings.

One pick-up with replaceable heads has an adjustable counterweight behind the arm pivot, with marks to indicate the correct position of the weight for each kind of record. This is not such a good scheme as the one where the plug-in heads automatically give the correct weight, since it makes just one more possibility of error in setting up the equipment, although this is not so serious as the one that is always present with plug-in heads, namely that of using the wrong head for the type of record to be played.

Another difference between the two kinds of record that is not as well known as it should be is that of frequency response. The response of a velocity-operated pick-up to both kinds of record is shown in Fig. 2, and it will be noted that there are two quite large differences. The ordinary 78 disk has the characteristic marked A on the diagram. It is flat from the highest recorded frequency down to what is known as the cross-over frequency, at which point it falls off at a rate of 6 db. per octave, down to the lowest frequency recorded. The cross-over frequency varies with different recording companies, and also according to the time at which the master was made, but the curve shown is that used by all the major British records at the present time. Here the cross-over is at 250 c/sec. The L/P characteristic used by the Decca company in England at the present time is given as curve C on Fig. 2. Here it will be noted that the cross-over occurs considerably higher up, and also that it has a slightly different shape in that part of the curve below the cross-over. In particular, the roll-off is less steep at the beginning, becomes steeper, reaches a slope of 6 db. per octave at about 120 c/sec., and then becomes less steep once more. There is a further, and even more marked difference at the higher frequencies. Starting at 1000 c/sec., the response rises continuously up to the highest recorded frequency, and at 15,000 c/sec. is as much as 15 db. up on the response at 1000 c/sec. This latter feature is of great importance,

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because it contributes materially to the very low noise level that the makers have achieved. It is called high-frequency pre-emphasis, and has been used in the manufacture of transcription records, for broadcast studio use, for a considerable time. It works in the following way. The noise which comes off the record—scratch, hiss, "pops," etc., occurs very largely in the upper end of the audio range. Also, once the record material has been decided upon, together with the other features of the system for making the records, the amount of this noise is fixed, and cannot be altered. Of course, the record material and the recording techniques are chosen as far as possible in such a way that the noise is as small as may be. What pre-emphasis does is to make the effect of this irreducible minimum smaller than it would otherwise be.

The high frequencies in the music to be recorded are put on the record at a higher level, compared with that of the lower frequencies, than is natural. Because of this, it is necessary when playing back the record, to use an amplifier with a *drop* in response corresponding exactly, both in frequency and degree, with the amount of boost used when the record was made. In this way, the frequencies in the music are reproduced at their natural levels. But at the same time, the use of a playback amplifier with a falling response at high frequencies, reduces the sound output of the scratch and other noise unavoidably present on the record. This happens because the amplitude of the noise components on the record is always the same, irrespective of the frequency response of the recording amplifier. For instance, it is always the same even if a blank groove were cut, with no amplifier attached to the cutting head at all. Thus, if there is a pre-emphasis of 15 db. at 15,000 c/sec., and the playback amplifier is arranged to have 15 db. drop at this frequency, then the noise on the record will be reduced by 15 db., while the musical frequencies occurring in this region will be brought back to the right level in comparison with all other frequencies.

It is this use of H.F. pre-emphasis, together with a new record material which is much quieter to begin with, that gives the L/P records their astonishingly low noise level, which is perhaps their greatest advantage apart from the increased playing time. However, more of this aspect anon.

The dotted curve, B, on Fig. 2, shows the small amount of high-frequency pre-emphasis used by the Decca company in making their "ffrr" 78 r.p.m. records that have also become very popular among gramophone connoisseurs. This amount of pre-emphasis hardly needs the special treatment that is required for proper playing of the L/P disks, with their considerably greater degree of pre-emphasis.

CONVERTING TO L/P

The above paragraphs indicate that the gramophone enthusiast will need to make some alterations to his equipment when he decides to start using L/P records. First of all, a turntable will be needed that will run at 33⅓ r.p.m. Because of the fact that both kinds of record will have to exist side by side for many years, and because most people will want to play both kinds, manufacturers of gramophone motors have brought out dual-speed motors. The actual motor runs at the same speed all the time, but the gearing of the motor to the turntable is arranged so that it can easily be changed so as to give the turntable either of the two standard speeds. In some models, a knob or lever is provided, so that all the operator has to do is to turn or press, and the motor takes up the desired speed. This is very convenient since it will not be necessary to have two separate motors. Also, excellent two-speed motors of the rim-drive variety are available at a very modest price—less than one used to pay for a 78 r.p.m. motor before the war. There is one very inexpensive two-speed motor on the market at a very low price. This motor has excellent speed constancy, and very low vibration and rumble, and its only disadvantage is that to change speeds, it is necessary to lift the turntable off, and change a small friction wheel that is attached to the motor shaft by a set screw. Considering its low price and excellent performance, however, this is a small disadvantage to put up with in order to be able to play the new records, since its price should be within the capacity of even the leanest purse. On the score of expense, this little motor makes it quite unnecessary to forgo L/P records. Having obtained the motor, there is the rather more vexed question of a suitable pick-up. There are on the market some excellent pick-ups with plug-in heads, and even the best of these are not inordinately expensive. Indeed one of the best of them is not as costly, even with two heads, as a good 78 pick-up was a few years ago. It is a safe bet, too, that more pick-ups of this kind will be available before long, giving the buyer a wider choice than he has at present.

Another solution that has been applied to the pick-up problem is that of the pivoting head. Some of these contain what is really two separate heads in a single cartridge. A small lever on the front of the arm enables either to be placed in the playing position, by the simple expedient of turning the assembly through 180 degrees. Others have only the one movement, but with two styli attached to it. A similar turn-over trick is used to bring the correct stylus into the playing position.

One very ingenious head of this kind has, instead of a single armature extension, a double one, in the shape of a V. At the end of each leg of the V is a stylus, off-set at a small angle. With this arrangement, the head has to turn only through a few degrees—enough to place one stylus vertical, and to lift the other a few thousandths of an inch clear of the record surface. Turning the head the other way interchanges the styli in the playing position.

Yet another idea that has been put into practice, and which is to be found on a three-speed record changer that is currently available here, is the dual-purpose stylus. This is simply a normal 78 stylus, with the rounded tip cut off, giving it a flat end, to which is attached a very minute tip suitable for playing L/P records. When this stylus plays 78 disks, the sides of the tip portion of the large part bear on the walls of the groove, just as if the hemispherical tip were still present, and the minute L/P tip clears the bottom of the groove. On an L/P record, the small tip, which is identical with the end of a conventional L/P stylus, plays the record in the usual way, while the shoulders formed by the truncated end of the large part clear the surface of the L/P record. This combination stylus acts as if it were two separate and distinct styli of different tip radius, so that when it is used, there is no need for a different head, for head tilting, or any of the other devices described above. In theory, this last scheme should be the best of all, but so far it does not seem to have been found so in practice. The difficulties that have been found are probably connected with the fact that 78 records have been made for a very long time, with a wide variety of groove dimensions, both width and depth. As a result, it is not unlikely that some 78 disks might let the L/P tip-stylus rest in the bottom of the groove, thus wearing the L/P tip, and spoiling the 78 reproduction at the same time.

However, it may well be that this difficulty can be overcome by suitable design. In the meantime, however, at least one maker who turns out separate 78 and L/P heads, as well as a single head with a combination stylus, recommends users to employ the separate heads. Of course this is good business, too, but it does appear that until time has proved the practicability of the combination stylus under all conditions, it would be safer to use either the separate heads, or the pick-up with two styli (turnover type).

FREQUENCY COMPENSATION

It is clear from the response curves of Fig. 2 that completely satisfactory results will not be obtained on high quality equipment designed for 78 records unless separate response compensation circuits are used for L/P disks. For less pretentious equipment, the use of the manual tone control will allow the excess H.F. output from the L/P records to be toned down satisfactorily, while there could easily be designed a compromise bass-correction network that would give acceptable results on both types. The subject of frequency compensation is complicated by the fact that some pick-ups are of the crystal type, which require quite different treatment from magnetic pick-ups, because the former have a response proportional to groove amplitude, while the latter's response is proportional to stylus velocity. The subject is too long a one to treat in any detail in an article of this kind, and so will have to be left for a later article.

DIFFERENCES BETWEEN L/P DISKS

So far, only one make of L/P record is on sale in this country, and this particular brand is known to be one of the best made anywhere. In America, however, many companies are cashing in on the initial L/P boom, and not all the L/P records offered there have all the advantages that one may expect. For example, some makers do not cut their master records on wax, but on cellulose nitrate. This is easier to process than a wax master, but has the disadvantage that to prevent the cutter from producing a noisy record, a special one has to be used which polishes the sides of the grooves as it cuts them, and at the same time polishes off the extreme high-frequency part of the audio spectrum. This kind of L/P record therefore has a noticeable lack of H.F. response. Similarly, many L/P records have been made in America by "dubbing" the programme material from existing 78 r.p.m. records. As a result, all that these particular records have to offer is the length of playing, the improved quality that is possible with microgroove recording having been completely eliminated. It is very easy to spot these records, because the surface noise from the 78 original is faithfully reproduced on the L/P version, since it cannot be eliminated. In a case like this, all the pre-emphasis in the world will not eliminate the noise.

ADVANTAGES OF L/P RECORDS

What then are the advantages that can be expected from the best L/P records? First and foremost, there is the long-playing feature. Next in order of importance is the exceedingly low noise level. There is no "needle scratch" whatever, and listening to recorded music without it is undoubtedly a revelation. The writer believes that a very great deal of the apparent distortion from which 78 records suffer must be due to the presence of a continuous surface noise, because the most noticeable improvement is that the reproduction sounds much

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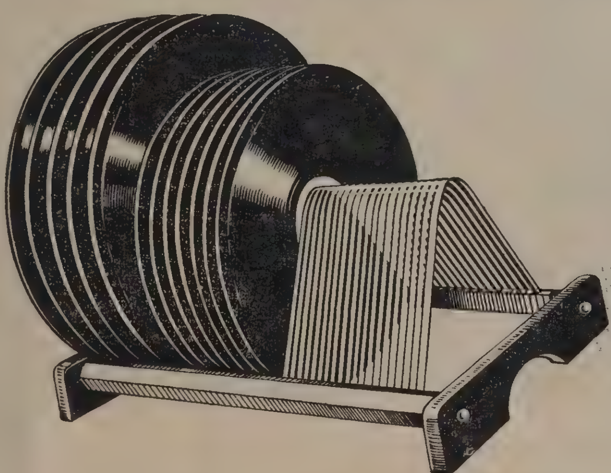

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"cleaner." This is not, perhaps a very satisfactory or scientific term, but anyone who listens to records will know what is meant by it. The lack of surface noise seems to give a presence to the music that very, very rarely seems to be there on a 78 disk. Oddly enough, when L/P records become worn, they do not develop the continuous surface hiss that a 78 record possesses from birth. Imperfections show up as individual popping or clicking noises, which seem to have much less annoyance value than the continuous noise we have become so accustomed to.

The frequency response and dynamic range of L/P records are at least as good as those of the best 78 recordings, and probably are both better. At any rate, the latter appears to the ear to be considerably better most likely because of the absence of hiss, to which the ear gives a greater importance than measuring instruments seem to.. There is less distortion on L/P records that can be traced to improper following of the groove by the stylus. This has come about because, in spite of the reduced speed of the L/P record, the ratio between the lateral stylus velocity and the forward velocity due to the record rotation, is less than in 78 recording. The immediate result of this is that the sideways excursions of the groove do not cut the direction of the unmodulated groove at such an obtuse angle, which makes it easier for the pick-up to follow the grooves faithfully. This also contributes to the "cleanness" of the reproduction in the upper register. The last, but by no means the least, advantage of the L/P record is that it must be played with a very light-weight pick-up, and as a result it maintains its original quality longer than a 78 disk. In addition, the difference in the character of the deterioration that ultimately does occur in an L/P record adds still further to the useful life of these records.

All in all, L/P recording is a very great technical advance, and in our opinion is one that will be hailed with delight by all quality fans. It is true, though, that increased perfection in the recording itself necessitates

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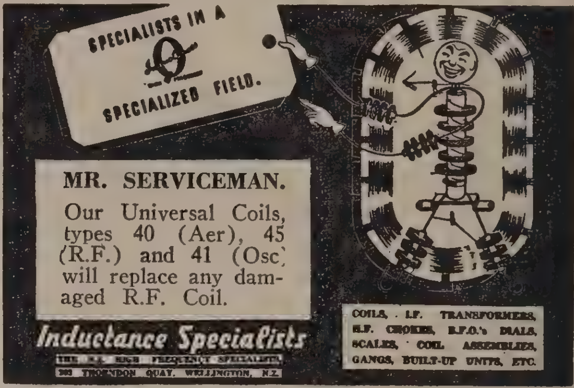
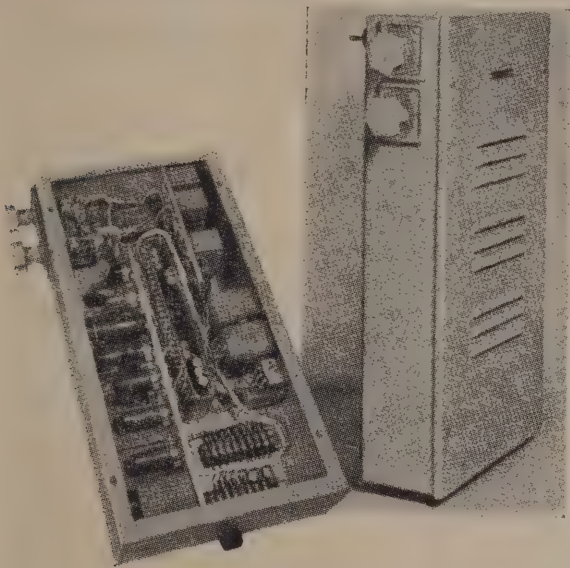


An Electronic Governor

One problem that continually grows in importance is that of maintaining electric power frequency more nearly constant throughout system surges and load changes. Now an electronic governor, designed by the Westinghouse Special Products Development Division, has been designed to give a lower static regulation with faster response. This unit was designed specifically for a small turbine-generator set, but is equally applicable to diesel and carburetor-type engine-driven governors and to large central-station equipments as well.



The cabinet and circuitry of the electronic governor.

The electronic governor can give a static regulation (change in frequency from no load to full load) of one half of one per cent. The amount of overshoot when recovering from a transient condition is limited to two per cent (about one cycle on 60-cycle equipment). And recovery time to a steady-state condition with sudden removal or addition of full load has been reduced considerably. This governor reacts to meet a load change on the system rather than to follow a change in load with a change in rotational speed to correct the unit to proper speed.

This governing system combines the high sensitivity of electronic circuits and the low-inertia, high-force characteristics of a hydraulic servomechanism to control the steam valves. The flexibility inherent in an electronic system is excellent. In the electronic unit it is possible, by varying the setting of standard potentiometers or changing the values of standard capacitors, to vary the stabilizing parameters of the governor over a range as wide as 100 to 1 within a matter of seconds.

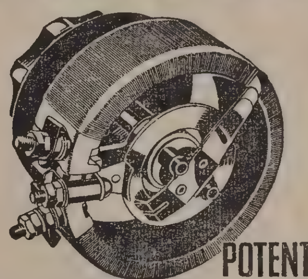
The basic part of the electronic unit is a frequency network that detects the variation from the basic frequency and provides a signal voltage proportional to this deviation. This signal voltage is operated on by a stability network and amplified to control the solenoid cup valve—the important connecting link between the hydraulic system and the electronic system. The solenoid cup valve, in turn, controls the hydraulically operated steam-inlet valves. The stability network introduces quantities related to the error signal that, combined with the error signal, detect—almost instantaneously—changes in frequency and thereby correct for delays occurring elsewhere in the system.

In addition, other circuits and networks improve performance during the various modes of operation. When the turbine generator is operating singly, an electronic representation of the power output of the generator is combined with the error voltage from the basic frequency network and is amplified to operate the solenoid cup valve. This improves the regulation and response characteristics of the turbine generator. In operating an electronic-governor-controlled turbine generator in parallel with a conventionally governed turbine or another electronically governed turbine, it is possible to maintain proper load sharing without using the conventional "droop method" (three per cent. or more regulation) of parallel operation. Difference in load between the two is measured electrically and introduced into the electronic circuit to cause the desired proportioning of load regardless of the regulation of either turbine generator.

This governor has been designed to meet high shock specifications and is therefore rugged and durable. The circuits are designed with tubes having a guaranteed life

(Continued on Page 48.)

CRESSALL



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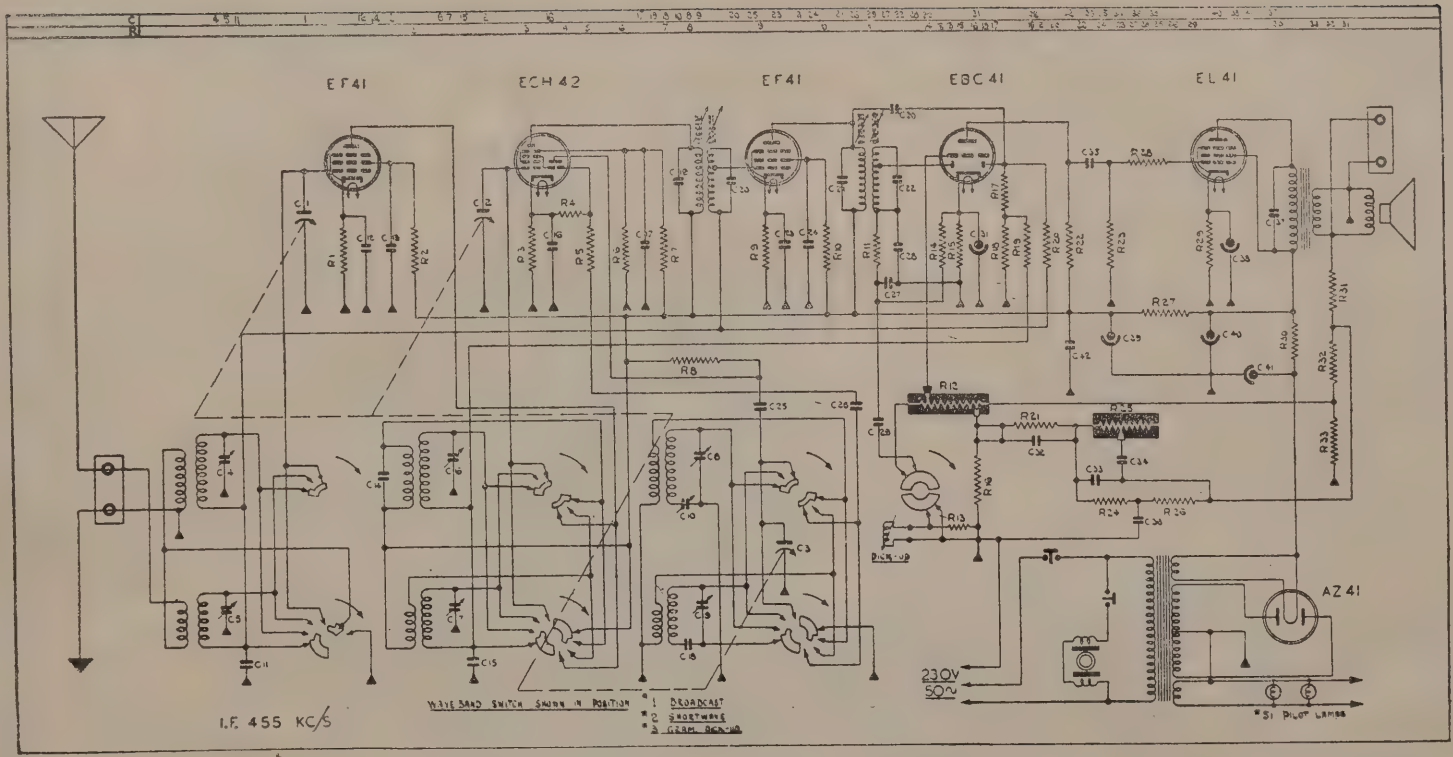
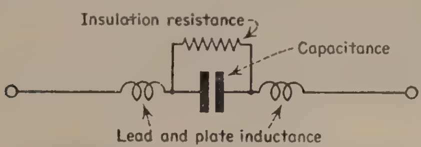


C1	Gang Tuning Condenser 13-438 mmfd
C2	Gang Tuning Condenser 13-438 mmfd
C3	Gang Tuning Condenser 13-438 mmfd
C4	3-30 mmfd Air Trimmer
C5	,, ,, ,,
C6	,, ,, ,,
C7	,, ,, ,,
C8	,, ,, ,,
C9	,, ,, ,,
C10	150-750 mmfd B.C. Padder
C11	.05 mfd 400V. Paper
C12	.05 ,, ,, ,,
C13	.01 ,, ,, ,,
C14	100 mmfd Ceramic
C15	.05 mfd 400V. Paper
C16	.05 ,, ,, ,,
C17	.01 ,, ,, ,,
C18	.004 mfd S.W. Padder
C19	110 mmfd Ceramic
C20	110 mmfd Ceramic
C21	110 ,, ,,
C22	110 ,, ,,
C23	.05 mfd 400V. Paper
C24	.01 ,, ,, ,,
C25	150 mmfd Ceramic
C26	56 ,, ,,
C27	100 ,, ,, } Diode Filter
C28	100 ,, ,, } Diode Filter
C29	.01 mfd 500V. Paper
C30	10 mmfd Ceramic
C31	25 mfd 25V. Electrolytic
C32	.02 mfd 400V. Paper
C33	.0004 mfd Mica
C34	.01 mfd 400V. Paper
C35	.02 ,, ,, ,,
C36	.01 ,, ,, ,,
C37	.0047 ,, ,, ,,
C38	25 mfd 25V. Electrolytic
C39	20 mfd 450V. } Triple Electrolytic
C40	40 ,, ,, } Triple Electrolytic
C41	40 ,, ,, } Triple Electrolytic
C42	.25 ,, 400V. Paper
R1	390 Ohms ½W. Carbon
R2	100 K ,, ½W. ,,
R3	220 Ohms ½W. ,,
R4	47 K ,, ½W. ,,
R5	220 Ohms ½W. ,,
R6	30 K ,, ½W. ,,
R7	47 K ,, ½W. ,,
R8	25 K ,, ½W. ,,
R9	390 Ohms ½W. ,,
R10	100 K ,, ½W. ,,
R11	47 K ,, ½W. ,, } Diode Filter
R12	2 Meg. Volume Control + Tap and Switch.
R13	25 K ½W. Carbon
R14	300 K ,, 1/3W. ,,
R15	2200 Ohms ½W. ,,
R16	25 K ohms ½W. Carbon
R17	470 K ,, ½W. ,,
R18	1 Meg. ½W. ,,
R19	2.2 Meg. ½W. ,,
R20	2.2 Meg. ½W. ,,
R21	250 K ohms ½W. ,,
R22	100 K ,, ½W. ,,
R23	470 K ,, ½W. ,,
R24	47 K ,, ½W. ,,
R25	.5 Meg. Tone Control
R26	6 K ohms ½W. Carbon
R27	2200 Ohms 2W. ,,
R28	25 K ,, ½W. ,,
R29	150 Ohms 1W. ,,
R30	500 Ohms 4W. ,,
R31	390 Ohms ½W. ,,
R32	27 Ohms ½W. ,,
R33	27 Ohms ½W. ,,

Fixed Capacitors in Modern Circuitry

By the Engineering Department, Aerovox Corporation

No other electrical component is called upon to perform such a wide variety of functions in electronic circuits as the capacitor. Most of these applications are based upon the ability of the condenser to differentiate between electrical currents of various frequencies. Such applications include D.C. blocking, ripple filtering, R.F. and audio by-passing, coupling, frequency determination, R.C. timing, and energy storage. Because of the varied requirements of these uses, fixed capacitors are made in many types and sizes, each especially engineered to fulfil a specific application or function. An important part of modern circuit design is therefore the choice of the proper capacitor for the circuit application at hand.



CAPACITOR EQUIVALENT CIRCUIT
FIG. 1

In many cases, the success or failure of the design will actually depend upon this choice. The radio engineer, experimenter, and amateur must therefore have a firm background in capacitor design and application. This article will review this material and point out certain important "kinks" in the use of fixed capacitors.

Probably the most direct route to a mastery of the "safe and sane" use of capacitors is to establish a thorough understanding of the characteristics and limitations of each general type. The choice of the proper type for each circuit application then becomes merely a matter of following good engineering practice. For this reason, we will commence with a discussion of the basic types of fixed capacitors which are encountered in electronic circuitry.

Since a capacitor is fundamentally two metallic conducting sheets isolated by a suitable dielectric material, the basic types are classified according to the type of dielectric used. They include:

Air Dielectric Capacitors
Mica Capacitors
Ceramic Capacitors
Paper Capacitors
Electrolytic Capacitors.

Just as all inductances have distributed capacity and resistance, and everyday resistors have some inductance and "end-to-end" capacitance, practical condensers are not perfect capacitances. All have a certain amount of residual inductance associated with the leads and plates, and also a finite value of resistance called the "insulation resistance." Thus, the equivalent circuit of any capacitor can be considered as in Fig. 1. The magnitudes of these unwanted characteristics vary through wide limits as a function of mechanical design and type of insulation or "impregnant" used, and must be considered along with such other characteristics as capacitance value, voltage and current ratings, temperature coefficient, stability, etc., in selecting a condenser for a particular job. The actual choice is usually a compromise between mechanical and electrical perfection on one hand, and the dictates of economy, space, and the practical requirements of the application on the other.

THE AIR DIELECTRIC CAPACITOR

From the standpoint of low losses (high capacitor) and constancy of capacity value, the most nearly ideal capacitors are built with air (or vacuum) as the dielectric between the plates. Such capacitors are not perfect, however, for although air is a perfect dielectric having zero power factor, some losses arise due to dielectric hysteresis in the insulating material used to support the plates. Charging currents flowing in the leads and plates cause additional power losses and give rise to some residual reactance.

The air-dielectric condenser occupies much more volume for a given capacitance and is usually more expensive than any of the other general types. The reasons for this are apparent from an inspection of one of the simpler empirical formulas for the capacitance between parallel plates whose dimensions are large compared with the spacing between them, so that "fringing" may be neglected:

$$\text{Capacitance } (\mu\mu f) = \cdot 2244 \text{ K A/D}$$

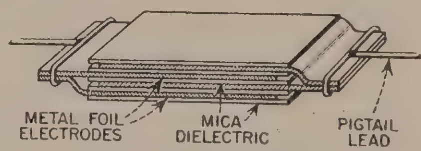
Where:

K is the dielectric constant of the material between plates.

A is the area of the smallest plate (sq. in.).

D is the distance between the plates (in.).

From this it is seen that the capacitance is *directly* proportional to the dielectric constant and the plate area, and *inversely* proportional to the spacing. Since the dielectric constant of air is only 1.0, but is greater than unity for all other insulating materials used in condenser construction, greater areas must be used in air capacitors to achieve a given capacitance. In addition, the dielectric strength of air is considerably lower than that of the other dielectrics, so that greater electrode spacings are necessary for a given working voltage. As a result, the volume occupied by an air-dielectric condenser will be 500 times greater than that of a comparable capacitor using a high grade mica dielectric (as is employed in all Aerovox mica capacitors).



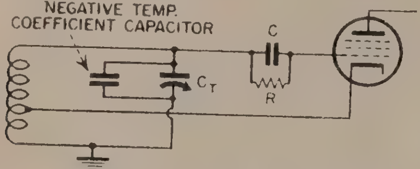
TYPICAL MICA CAPACITOR CONSTRUCTION
FIG. 2

Because of these factors, air as a dielectric is used only to a very limited extent in fixed capacitors, such as in certain laboratory capacitance standards. Fixed capacitors using vacuum or an inert gas under pressure are used to a greater extent, since the breakdown voltage is increased about four to ten times thereby. Air dielectric *variable* capacitors are, of course, widely used for tuning R.F. circuits because of their mechanical simplicity.

MICA CAPACITORS

Mica is widely used as the insulating material in capacitors manufactured primarily for R.F. applications.

The mica capacitor is characterized by low power factor, high puncture voltage, good stability, high insulation resistance, and reasonable cost. As mentioned above, the size for a given capacity is considerably smaller than that of a comparable air-dielectric condenser. Due to the stacked construction usually employed, the inductance is quite low. A common construction is illustrated in Fig. 2 The plates consist of metal foil sandwiched between thin sheets of mica dielectric material. The ends of alternate foil strips extend beyond the mica sheets at opposite ends of the stack and each group is clamped together and connected to a lead. Thus, the charging currents which flow into each plate do so through a relatively short, broad path. Therefore, the inductance is low, being mainly that contributed by the wire leads.



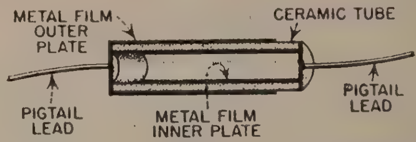
USE OF TEMPERATURE COMPENSATING CAPACITOR
FIG. 3

Mica capacitors are used in a multitude of electronic applications where a high degree of capacitor excellence is required. Such uses include: R.F. fixed tuned circuits, R.F. coupling, D.C. blocking, R.F. neutralizing, R.F. filtering, A.F. tone control, A.F. degenerative feedback, A.F. coupling where high insulation resistance is important (as in certain R.C.-coupled amplifiers), and many others.

In radio frequency applications, mica capacitors are rated according to R.F. current handling capability as well as maximum instantaneous voltage. The observance of both of these ratings are equally important in practice. Excessive R.F. current results in capacitor heating, which, in turn, causes increased dielectric losses, capacitance deviation, and lowered breakdown voltage. The effect is thus cumulative. The R.F. current through a capacitor in any given application can be determined by connecting a suitable R.F. thermoammeter in series with it.

In applications where stability of capacitance value is important, as in tuned circuits, R.F. filters, and other critical circuits, capacitors of the "silvered mica" variety are used. These units have extreme capacitance stability and low temperature coefficients. (The Aerovox types 1464-1469-1479 have a positive temperature coefficient of only 30 parts per million per degree Centigrade.) These excellent characteristics are obtained by depositing a silver coating on the opposite surfaces of mica wafers and "sintering" this assembly at high temperature to form highly conducting metal "plates" in intimate contact with the mica. The variable factor of stacking pressure is thus drastically reduced, with correspondingly improved stability.

High quality mica units are manufactured with either positive, zero, or negative temperature coefficients of capacitance. Capacitors of this type (such as the Aerovox "K" units) can be used for temperature compensation in tuned LC circuits in which low frequency drift with ambient temperature change is important. By such means, self-excited R.F. oscillators having frequency stability comparable to crystal controlled oscillators can be built. Stabilized oscillators of this type are used for receiver local oscillators, amateur V.F.O.s, power oscillators where crystal control is impractical, etc. An example of the application of temperature compensating mica capacitors is given in Fig. 3. Here it is desired to maintain the LC product (and hence the frequency) of an R.F. oscillator "tank" circuit at a constant value over a wide temperature range. This may be accomplished by determining the approximate temperature coefficient of the uncompensated circuit in terms of capacitance deviation in parts per million per degree Centigrade. This coefficient will usually be positive with common circuit elements, i.e., the frequency decreases with increasing temperature. Temperature compensation then consists of the selection of a capacitor having a *negative* temperature coefficient approximately equal to the *positive* characteristic of the other circuit elements. Thus, with all circuit elements subjected to the same ambient temperature changes, frequency "drift" is compensated. A trick frequently resorted to by circuit designers consists of placing the compensating capacitor at a location in the equivalent where a temperature gradient exists, such as near a vacuum tube. A "vernier control" of temperature compensation is then obtained by adjusting the position of the capacitor within this gradient by trial and error until a point of best frequency stability is located.



CERAMIC CAPACITOR CONSTRUCTION
FIG. 4

THE CERAMIC CAPACITOR

Another type of condenser which in some cases is comparable to the mica capacitor in electrical characteristics uses a ceramic as the dielectric material. A typical design is shown in Fig. 4. The capacitor plates are deposited on the inner and outer surfaces of a ceramic tube with connecting leads at either end. This unit is then sealed in a second ceramic tube and the whole assembly is wax impregnated for moisture proofing.

Ceramic capacitors are manufactured in a wide variety of characteristics, depending upon the type of ceramic used for the tube upon which the electrodes are deposited. Since some of the ceramics have very high dielectric constants, the volume efficiency (micromicrofarads, cubic inch) is high. Titanium dioxide ceramics, for instance, are used extensively for their high dielectric constants (90-170), low losses, and low temperature coefficients. Since the temperature coefficient can be controlled by the ceramic mixture, units ranging from essentially zero to high negative values of temperature coefficient are available for temperature compensation. Due to the coaxial type of construction, tubular ceramic capacitors have low values of residual inductance.

One grade of ceramic capacitor is used interchangeably with mica capacitors in critical R.F. circuits, while a lower quality variety which has very high volume efficiencies but poor stability, is used for general purpose applications such as by-passing. Ceramic tubular capacitors are usually more expensive than equivalent mica units. However, disk type ceramic capacitors are less

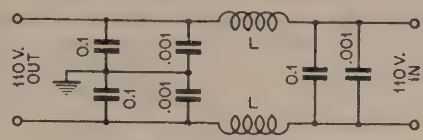
expensive than equivalent mica capacitors and are sold on a "guaranteed minimum value" basis. Disk ceramics are used in high frequency by-pass applications only.

PAPER CAPACITORS

Capacitors using wax or oil impregnated paper dielectric are employed extensively in D.C., audio, and low frequency R.F. applications where high capacitance per unit volume and low cost is required. They are characterized by generally poorer electrical characteristics than mica or ceramic capacitors, including: higher power factor, larger temperature coefficients, lower operating voltages, higher inductance and shorter life. These factors depend to a large extent upon the type of impregnant used, the purity of the impregnant, the method of construction, and the casing employed.

Wax is used as the impregnant in a large variety of utility capacitors for the lower voltage ratings, where small size and economy are important. The tubular capacitors used in receiver audio, blocking, and by-pass work are examples. Moisture absorption shortens the life of cardboard-cased capacitors to some extent, as does high ambient temperature.

Castor oil (Aerovox Hyvol), mineral oil, and chlorinated synthetic oils such as "askerels" are used in paper capacitors for higher operating voltages and greater dependability. Mineral oil filled units have the best temperature characteristics and lower power factors, but are about 35 per cent. larger in volume because of the lower dielectric constant. For this reason, castor oil filled condensers are used in most non-critical applications or where space is at a premium.



ILLUSTRATING USE OF DUAL BY-PASSING
FIG. 5

Typical paper condensers have temperature coefficients of capacitance approximately ten times larger than high grade mica capacitors, such as the silvered-mica types. Power factors are greater by at least one order of magnitude and inductances are larger, especially in the types using paper-foil rolled construction in which the contact tabs are at the ends of the rolled foil plates. In paper capacitors of advanced design (such as the Aérovox Type P123ZG Metallized-paper Subminiatures), residual inductance is minimized by the use of the extended electrode construction, in which electrical contact is made at the edges of the rolled electrodes, so that charging-current paths are short.

In applications where a wide range of frequencies must be effectively by-passed, as in the TV line filter shown in Fig. 5, a high-capacitance paper capacitor may be used in parallel with a small mica unit. Otherwise, the

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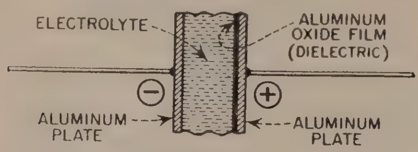
residual inductance of the paper condenser may make it ineffective as a by-pass for the high R.F. frequencies.

Another by-passing device used in video I.F. amplifier design consists of using capacitors which are *self-resonant* at the frequency to be by-passed. A value of capacitance is chosen which is series resonant with the inherent inductance of the capacitor and its leads. This type of single-frequency by-passing is very effective.



ELEMENTARY ELECTROLYTIC CAPACITOR
FIG. 6

THE ELECTROLYTIC CONDENSER

The familiar electrolytic capacitor is the "work horse" of the receiver power supply filter field. These units have extremely high volume efficiencies, occupying only about 15 per cent. of the space required for equivalent paper capacitors. The cost per microfarad is also very low. For these reasons, although inferior in most other respects to the other types, the electrolytic capacitor is extensively used for filter and by-pass applications.

An electrolytic capacitor may be made either by immersing two aluminium electrodes in an electrolytic solution such as ammonium borate or sodium phosphate (a "wet" electrolytic) or by filling the space between rolled foil electrodes with a thick paste of similar material (the "dry electrolytic). A "forming voltage" applied between the plates deposits a film of aluminium oxide on the positive plate. See Fig. 6. This film is the dielectric material of the capacitor. Because it is extremely thin—being only .000025 inch thick in some cases—the capacitance per unit area is very high. For the same reason, the operating voltage of the unit is limited to about 450 volts. Electrolytics may, however, be used in series for higher voltages with the use of the usual voltage equalizing resistors shunting each unit, as must be used wtih mica and paper capacitors which have higher insulation resistances.

The electrolytic condenser is essentially for D.C. applications, since to maintain the oxide film, the plate bearing it must never become negative. If A.C. components are present, they must be smaller in voltage than the steady D.C. voltage impressed.

The high leakage current of the electrolytic becomes much greater after prolonged inactivity, but soon drops to a normal value of about 200 microamperes per microfarad. The wet electrolytic has been used in voltage limiting applications because of its particularly steep leakage-current versus applied voltage characteristic.

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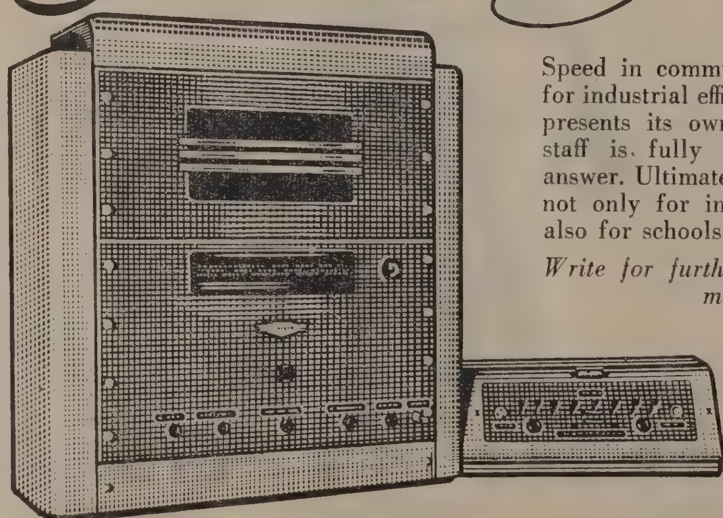

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Low-Hum Amplifiers

HEATER-HUM REDUCTION TECHNIQUES EVOLVED

Heater-induced 50-cycle hum in A.C.-operated low-level amplifiers, which in some instances has been found to yield a 500-microvolts level, can be substantially minimized by adopting better tube-and-circuit combinations, according to the National Bureau of Standards electronic instruments lab. In a recent survey of the problem, it was found that the hum can be reduced to less than 1 microvolt through a suitable solution of tubes and circuits.

Eleven tube types, in various circuit arrangements, were studied. Included were single triodes 6F5 and 6SF5; dual triodes 6SL7, 7F7, and 5691; and pentodes 6J7, 6J7G, 6J7GT, 6SJ7, 5693, and 6SH7.

Circuits were varied with respect to cathode bypass capacitance, heater return tie point, heater return potential, and grid circuit resistance. The cathode resistor was either bypassed with a 50 $\mu\mu$f. capacitor or left unbypassed. Input grid resistance was either zero or 0.5 megohm. The heater return was either to one side of the heater or through the adjustable arm of a 100-ohm potentiometer placed across the heater supply and adjusted for minimum 50-cycle output. Heater return potential was either to ground, to 45 volts positive, or to 45 volts negative. Hum measurements were made with various combinations of these circuit variations.

In the test set up, the 60-, 120, and 180-cycle hum components of the output of the amplifier under study were measured on a V.T.V.M. using appropriate amplification and filtering. At the same time, waveform was observed on a 'scope. Gain was measured by applying a known signal to the grid of the test amplifier; hum level could then be expressed in terms of equivalent microvolts at the grid. Provision was made for the switching from A.C. to D.C. heater supply for calibration and comparison.

To obtain the desired measurements of heater-induced hum, external A.C. hum was reduced to a negligible value, using recognized shielding precautions; heater leads were twisted and shielded and kept away from the grid circuit, which was also shielded. Circuit components were based on median values given in manufacturers' manuals. Preliminary checks indicated that hum is not significantly affected by the usual variations in components—plate, screen, and cathode resistors, and cathode and screen bypass capacitors—required to match different load impedances.

The most hum-free amplifiers investigated so far used either of several triodes (6J5, 6SF5, 7F7, or 5691) or a pentode (5693), in a circuit including bypassed cathode, heater grounded through an adjustable potentiometer, and low grid impedance. Wide hum differences were found for different tube types, as well as for different circuit arrangements. It was found that the 60-cycle equivalent input hum of almost any tube type tested, whether triode or pentode, can be reduced to 10 microvolts by suitable circuitry; and all of the triodes tested could be brought below 2 microvolts.

Return of the heater circuit through an adjustable potentiometer connected across the heater supply, when

(Continued on page 48)

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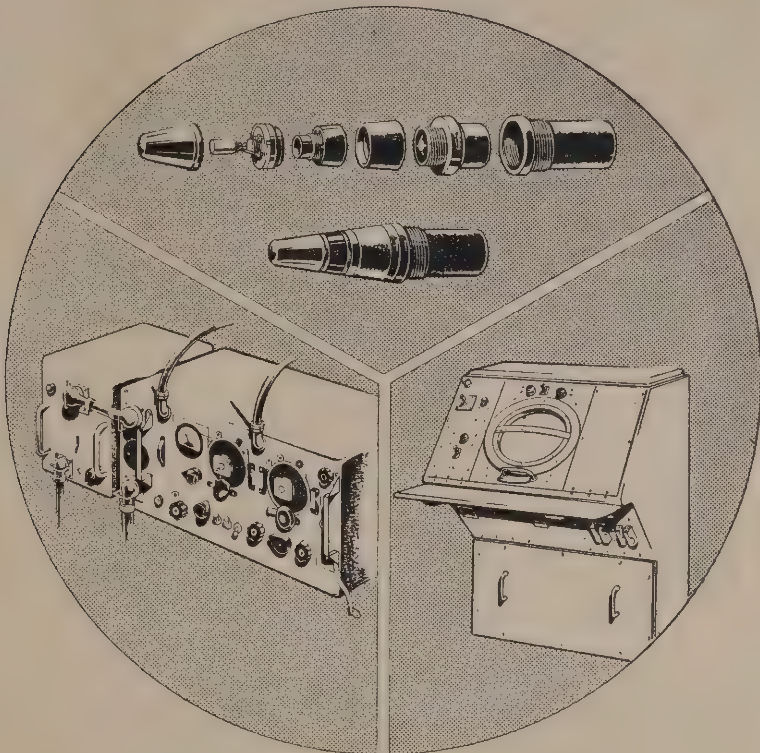

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The PHILIPS Experimenter

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No. 52: A Practical S.S.S.C. Generator Using the Phasing Method—Pt. III

The second instalment of this series completed the description of the circuit and construction of the S.S.S.C. generator, up to and including the balanced modulators. It now remains to describe the steps that must be taken to put the circuit into operation.

First of all, it is advisable, if possible, to check the performance of the audio section, since this makes up the majority of the circuitry in the unit. The overall gain is sufficient to handle the output of a diaphragm type crystal microphone, so that only a small input voltage is needed for testing purposes. The signal voltage at each input terminal of the phasing network needs to be about 20 volts, so the first thing to do is to ensure that V_4 and V_5 give an undistorted output voltage in excess of this figure. In testing and setting up the unit, an oscilloscope is essential, since by its aid, everything one needs to know about the performance can be found out very quickly. A very simple 'scope is all that is necessary, because at all the test points, plenty of signal voltage is available, so that amplifiers are not needed. For initial testing, a variable frequency audio oscillator is very helpful, but not essential. A simple single frequency audio oscillator will do quite well for all routine checks, such as are necessary if the radio frequency is changed, and those who intend to operate S.S.S.C. to any extent would be well advised to construct a small one-valve phase-shift oscillator, which can be powered from anything that is available, or even from batteries, and which can be kept as an inexpensive piece of permanent test equipment. In the first place, then, we will assume that the reader has been able to beg, borrow, or steal the use of a 'scope and an audio oscillator.

On first switching on, the balanced modulators can be left out of their sockets. The audio oscillator is applied to the input terminals, and the 'scope is attached to the cathode of either V_4 or V_5. The volume control, R_1, is advanced to the point where the scope shows that distortion has started to occur, and the output voltage is noted by measuring the size of the wave on the screen of the C.R.T. If one has no idea of the sensitivity of the cathode ray tube, an accurate enough calibration can be made up by connecting a 45-volt battery from earth to the Y plate that is being used for the application of the signal voltage. The shift in the position of the trace is then measured, whereupon a little arithmetic will give the deflection factor of the tube in terms of volts D.C. per inch of deflection. To apply this knowledge to the deflection produced by a sine-wave, we then divide the figure thus obtained by 2.82, and this gives the R.M.S. voltage that produces one inch of total deflection on the tube. For example, if the D.C. deflection factor is 100 volts per inch, and it is found that an A.C. wave, measured from peak to peak, gives a deflection of one inch, then the peak voltage of the wave is 50 volts, and the R.M.S. voltage is 35·35 volts, which is $100 \div 2{\cdot}82$. Of course, if one has a V.T. voltmeter that can be attached to the test point at the same time as the oscilloscope there will be no need to calibrate the 'scope, which can then be used solely to indicate the wave shape. After checking that the cathodes of V_4 and V_5 can give a greater undistorted output than 20 volts, the input control is then moved until approximately this voltage is delivered from each cathode to the input terminal of the phase-shift network. The 'scope can then be transferred to the grid of V_6 and then to the grid of V_7. The signal voltage at these points will be found to be considerably reduced, but this is normal, as the network produces some attenuation, which is made up for by the subsequent amplifying stages. The purpose of the control R_{27} is to equalize the audio output voltages from the two push-pull amplifiers that precede the balanced modulators. For this reason, there is no point in adjusting R_{27} so as to give equal inputs to V_6 and V_7. However, as a check that all is well with the phase shift network, and with the circuits of V_3, V_4, and V_5, it is as well to note the amplitude obtained from the grid of V_6, and then to check that by adjusting R_{27} it is possible to get the same amplitude as at the V_6 grid, with some to spare when R_{27} is turned right up. If this cannot be done, as, for instance, if the output at the grid of V_7 is always less than that at the grid of V_6, irrespective of where R_{27} is set, V_3, V_4, and V_5 should be checked over. More peculiar things have happened than finding a 10k. resistor where a 100k. one should be, and should some such mistake have been made, it is far better to rectify it at this stage rather than after one has found that the whole thing fails to work according to the book. When the voltage at the grids of V_6 and V_7 has been checked, the voltages at the grids of V_8 and V_9 should be looked at. These are the two outputs of the phase inverter, V_6, and should be equal and identical in shape. The grids of V_{10} and V_{11} are then checked similarly.

Next, the 'scope is transferred to the plate of V_8. At this point some distortion might be found, if the input to the phase shift network has been adjusted to 20 volts, but this does not indicate a fault. It can be rectified by turning down the input control until V_8 is below the overload point, so that the wave is again undistorted. The 'scope is then connected to the plate of V_9, and a check is made to see that it is possible, by adjusting R_{41}, to obtain equal audio outputs from V_8 and V_9. Adjustment of R_{41} need not be expected to make a very great difference to the voltage output at either plate, because triode amplifiers are not very critical to reasonable changes in the value of the plate load resistor. The real purpose of R_{41} is to make a differential adjustment of the screen voltages of V_{12} and V_{13} in order to equalize their gains, even though their characteristics may not be identical. In doing this, we are relying on the fact that R_{41} does not make much difference to the balance of the audio voltages produced by V_8 and V_9, to allow the screens of the EF50s to be adjusted without sensibly affecting the audio section, in spite of the direct coupling between the audio plates and the modulators' screens. After this check has been made, a similar procedure is followed for V_{10} and V_{11}. This completes the checking of the audio section.

Any troubles which may be found by the procedure outlined above should be easily fixed, since the circuits are all simple and well-known A.F. ones, which are sub-

ject to all the usual rules. As was pointed out earlier, for instance, the only reason for unbalance in the phase inverters is inequality of the plate and cathode load resistors, while for the cathole followers V_4 and V_5, equal gains should depend solely on the values of R_{16} and R_{17} being equal, except in the case of a defective valve. In spite of the large number of tubes used, no difficulties such as motor-boating or oscillation will be encountered, nor are there any critical values anywhere in the circuit excepting the ones that have already been indicated, and these are only in the phase shift network.

TESTING THE PHASE-SHIFT NETWORK

If the network has been built according to instructions—that is with parts of the required accuracy—there is little that can be done with it, but it is a good thing to assure oneself that it is functioning properly. This is where the variable frequency audio oscillator comes in. The testing of the valve circuits should be done with a signal of about 1000 c/sec., although anything between 700 and 1500 c/sec. would be perfectly satisfactory. In order to test the phase-shift network, we proceed as follows. The audio oscillator is applied to the input terminal, and the gain control is adjusted so that an undistorted output is obtained, fairly well below the maximum of which the circuit is capable. For this initial test, the Y plate of the 'scope should be applied to the plate of V_8 or that of V_9—it does not matter which. Next, the X plate of the scope is disconnected from the internal time-base, and instead is connected to the plate of either V_{10} or V_{11}. When this is done, something approximating a circle should be seen on the screen of the C.R.T. It does not matter much if it is an ellipse instead, because there are several things which can cause the trace to be elliptical, even if the gear is working perfectly. In theory, of course, the trace should be a perfect circle, showing that the two voltages applied to the plates are exactly 90° out of phase. However, a circle will not be obtained if the X and Y plates of the oscilloscope are not equal in sensitivity. Similarly, if the outputs from the circuit to the deflection plates are not equal, the trace will again not be circular. In order to get as nearly a circle as possible, R_{27} can be adjusted until this comes about. If adjusting this control only makes things worse (*i.e.*, more oval instead of more circular) the 'scope leads are reversed, and R_{27} is tried again. When an almost circular trace has been achieved, the audio oscillator is run over the entire audio frequency band, and the effect is observed. It will be noticed that as this is done, the shape of the trace alters continuously, sometimes passing through a perfect circle, and then deteriorating into an ellipse sloping in different directions, at different times, according to the frequency. The reason for these changes is that there are only certain frequencies at which the phase difference produced by the network is exactly 90°. At all other frequencies, the phase difference is close to 90° but not quite that, and, since the 'scope pattern is very sensitive indeed to small phase changes, the result is the continually changing pattern.

It will be noticed that below 300 c/sec. and above 3,000 c/sec., the pattern does two things. First of all, its size becomes rapidly smaller. This is accounted for by the top and bottom cut that has purposely been incorporated in the speech amplifier section, with the object of removing those frequencies at which the network cannot be expected to give its designed phase shift to within a few degrees. At the same time as this falling-off becomes apparent, it is obvious that the network's performance is falling off, because the pattern begins to depart greatly from circularity. This behaviour is normal, and to be expected. As long as the run through the range between 300 and 3,000 c/sec produces an approximately circular pattern, which passes through true circularity at several points, then all is in order, and we can proceed to feed in the R.F.

R.F. ADJUSTMENTS

Having got thus far (and the above has been outlined more with the idea of familiarizing the builder with the gear than in expectation of difficulty) the next thing is to provide a source of R.F. This can be a crystal oscillator or a V.F.O. capable of putting out two or three watts in the 80m. band. A piece of twisted pair, or a bit of co-ax. cable is connected to the "R.F. in" terminal, and its other end is terminated in a two- or three-turn link, which can be variably coupled into the output tank of the R.F. source. The EF50s are plugged in, the S.S.S.C. unit and the signal source are turned on, and the A.F. gain control is turned right down. As an indicator, the 'scope is again employed, the best way being to attach the Y plate to one end of the output tank circuit through a 5 or 10 $\mu\mu$f. condenser. The X plate is attached to the time-base as usual. Then the R.F. output shows as the deflection in the vertical direction, no differently from an audio wave applied to the Y plate, except that the individual cycles of R.F. cannot be distinguished. The tank condenser, C_{28}, is then tuned for maximum output as shown by the 'scope. Thereafter, there is no need to re-tune this condenser. When the tuning is done, considerable output will be present, because no attempt has yet been made to balance the modulators. When this is done, the output will drop to zero, because the first essential action of the balanced modulators is to balance out the carrier. However, carrier needs to be present to enable C_{28} to be tuned in properly, so the tuning is done before the balancing.

R_{41} is now adjusted for *minimum* carrier output. The residual carrier present before any of the balancing controls have been touched consists of two parts—that produced by the upper balanced modulator circuit, and that from the lower one. These two modulators act quite independently, so that their balancing can also be done independently of each other. Thus, if R_{41} enables the upper modulator to be balanced properly, the result will be a pronounced dip in the R.F. output. When R_{41} has been set to the position described, it is left in that position, even if it is hard over to one side, and a proper minimum has not been found. R_{45} is then adjusted similarly, and it will be found that even if perfect balancing is not obtained, the result will be a much smaller output than what was found at the start. Of course, it is desirable to have pairs of tubes in the two modulators that are as accurately matched as possible, for should they be exactly matched, R_{41} and R_{45} will finish up set exactly at the centre of their travel, if they are linear potentiometers. In all probability, the first trial will not enable anything like zero carrier output to be obtained, in which case one or both of the balance potentiometers will be found hard over. This indicates that the pair of EF50s associated with that potentiometer are not well matched. Should this occur, both tubes of the other modulator circuit should be removed, and the four tubes used to find a pair that are better matched—well enough to enable almost zero R.F. output to be obtained, and that at almost the centre of the potentiometer's travel. When this has been done, the remaining two tubes are re-inserted, and without touching the circuit that has already been balanced up, an attempt is made to balance

(Continued on page 31)

The Use of Cored Solder in Radio and Television Production

During the last twenty years methods of soldering have been revolutionized by the introduction of cored solders. For centuries prior to the development of the radio industry soldering had been largely undertaken to provide mechanical joints. By 1930, however, with the introduction of mass production in the assembly of components for radio equipment, a means had to be found whereby many millions of joints to provide electrical conductivity could be undertaken in a factory each week by comparatively unskilled labour with a reasonable degree of reliability. The making of joints in electrical equipment also necessitated the use of fluxes which were entirely non-corrosive and the residue of which would not affect the joints or the components over a period of time. For many years resin was the only flux used which would meet these requirements and thus the early types of cored solder incorporated a core of resin.

Soon after quantity production of radio commenced most of the world's large radio manufacturers were using cored solder, but many of them employed also an additional flux, for no reliable method had been found of ensuring that the flux was incorporated continuously in the solder. The method for producing the cored solder was itself very crude and often involved the extrusion of a tin/lead alloy in the form of a tube which was subsequently filled with flux. Generally, the solder was extruded in its final diameter with the result that for many years the radio and telephone industries were unable to use a finer diameter solder than 13 S.W.G. Owing to the difficulty of incorporating the flux and the comparative inefficiency of resin the proportion of flux to solder was usually in the order of 10 per cent. This was extremely wasteful for no radio manufacturer desired to purchase more flux than was necessary.

About 1934 an English research laboratory, which had no preconceived ideas regarding the manufacture of cored solder, decided to commence a series of investigations to determine whether it was possible to manufacture cored solder of a vastly superior quality to that which had been offered hitherto and to see whether such solder could be made in large quantities by precision methods.

INTRODUCTION OF 3-CORE SOLDER

Some years' investigation resulted in the production of Ersin Multicore Solder, a solder having three cores of flux and which was manufactured by introducing the flux into the cores at the time of extrusion and subsequently drawing the wire to the required finished diameter. The advantage of having three cores of flux was to ensure that even if interruptions occurred owing to air pockets in the extrusion operation there would still be sufficient flux in two cores to provide satisfactory joints. By distributing the flux over a cross section of the wire, instead of it being incorporated in the centre, a more rapid melting of the solder was achieved.

FLUXING ABILITY OF RESIN

As mentioned previously, it had been known for many years that whilst resin had the desirable properties of being entirely non-corrosive it was extremely slow in soldering speed and enabled joints to be made only on freshly tinned components. In modern radio production it is not always possible to ensure that the components to be soldered have not become oxidized and thus there was an urgent need for a flux which would have much greater soldering speed than resin but still possess the desirable properties in respect to non-corrosion.

The obvious course was to try to increase the fluxing ability of resin, and this was achieved with the introduction of Ersin flux, which is a high-grade resin which has been subjected to a complex chemical process to increase its fluxing action to the highest possible degree without impairing in any way the well-known non-corrosive and protective properties of the original resin. In effect, resin, which by itself is a slow-acting flux, suffices only as an agent to avoid oxidation during soldering, whereas Ersin flux which in addition has been chemically "activated" to ensure speedy action, will not only remove surface oxide but also prevent their further formation during the soldering operation.

FREEDOM FROM DRY JOINTS

The rapid production of the vital radio and radar equipment in Britain during the 1939–45 war by female labour which hitherto had no experience of soldering was made possible by the use of Ersin Multicore Solder. The great degree of freedom from high resistance and dry joints when using this product led to its adoption post-war by the majority of the leading television and radio manufacturers throughout the world. In fact, Ersin Multicore Solder manufactured in England is now used in more than fifty countries and substantial quantities are even shipped weekly to the United States.

Naturally the success of Ersin Multicore Solder has led other cored solder manufacturers to improve their production techniques and other activated fluxes have been introduced. Not all of these have proved entirely satisfactory because the manufacture of an activated yet non-corrosive flux is a very complex chemical procedure and the Halide content has to be carefully controlled. It is also important to ensure that when the cored solder is used under production conditions the flux fumes are in no way distressing to the operatives. As a result of these considerations the bulk of radio and television manufacturers continue to use Ersin Multicore Solder which has proved so successful over so many years.

TREND TOWARDS FINER GAUGES

During the past five years certain trends have been noticed resulting from the activity of the Ersin flux and the miniaturization of many radio and television components. Whereas ten or so years ago 13 S.W.G. (2.3 mms.) was the diameter largely used on the assembly benches there has been a general trend to finer gauges and 16 S.W.G. (1.6 mms.) is now probably the standard, while many firms use 18 S.W.G. (1.2 mms.). As a result of the activity of the flux economies have been achieved by incorporating a smaller percentage of flux in the solder and the British Standard Institution recently amended their specification to provide for a much lower flux percentage, which for a product such as Ersin Multicore Solder is now around 2.5 per cent.

MELTING RANGE OF TIN/LEAD ALLOYS

Speed of soldering bears some relation between the speed of the flux, the heat of the iron, and the melting point of the solder. All tin/lead alloys between 60 per cent. and 20 per cent. tin content become solid at 183°C. (361°F.). It is usually the practice to quote tin/lead alloys with the tin content first and thus 60/40 alloy is 60 per cent. tin content and 40 per cent. lead. This alloy becomes liquid at 189°C. (372°F.) and is thus

said to have a plastic range (*i.e.*, the period between becoming solid and liquid) of 6°C. (11°F.). As the tin content becomes lower the plastic range increases and thus 28/80 alloy has a liquid melting point of 275°C. (527°F.) with a plastic range of 92°C. (166°F.).

Tests undertaken in the Multicore Research Laboratories have shown that variations of bit temperature of up to 100°C. occur between irons of different manufacture but of the same wattage. When undertaking the jointing of components, the aim should be to complete the joints in the shortest possible time, and thus it is desirable to apply sufficient heat quickly rather than apply too low a heat for a long period. If the latter procedure is adopted it is inevitable that the heat will be transferred from the soldering tags to other parts of the components if the tags ever reach the liquidus of the solder.

CHOICE OF ALLOYS

The choice of a suitable alloy for radio and television production must lie between 60/40 and 40/60, but because of the comparative inefficiency of most electric irons higher tin content alloys are being more and more used with particular emphasis on 60/40. The greater initial cost of the higher tin content alloy has been more than offset by the major economies gained from the use of the finer gauge solders. Other contributing factors being the freedom from dry or imperfect joints and easier flowing of the alloy.

TWO IRONS PER OPERATIVE

In order to provide rapid soldering, in many U.S.A. factories, each operative is provided with two electric irons and changes from one iron to the other after a specified number of joints have been soldered. It is hardly necessary to state here that cored solder should never be carried on the iron to the joint, but this is a point which must be borne in mind when training new labour. It is also advantageous to provide each operative with a scratch pad to encourage him or her to remove frequently the oxide which has accumulated on the bit of the iron. In any assembly line employing twenty or more operatives engaged upon soldering operations, it should be the duty of a foreman or maintenance man to inspect at least once a day, but preferably twice, the bits of the soldering irons to ensure that their shape has not been deformed to such an extent that good contact cannot be achieved between the irons and the components.

In conclusion, it must be realized that under present conditions the efficiency of electric irons can be prejudiced by power cuts and reduced supply voltages due to additions to wiring of assembly lines. It is of little use employing the finest cored solder in the world if the equipment used for making the joints is below standard.

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Wellington Radio Traders' Association

Minutes of the Executive Meeting of the Wellington Radio Traders' Association, held at the office of the Secretary, 8–12 The Terrace, Wellington, on Tuesday, 27th November, 1951, at 3 p.m.

Present: W. Young, Esq. (in the chair), Messrs. D. B. Billing, S. Oxley, and P. J. Luxford, Secretary.

The meeting was called to consider a letter sent to the Association by the Membership Committee.

The following decisions were reached:—

1. The Membership Committee be asked to undertake the additional duty of checking of bona fides of new licencees and also the responsibility for additions and deletions to the Wellington section of the Register of Bona Fide Radio Dealers and Servicemen.

2. No direction has been given by this Association that non-members shall not receive trade discounts. Despite the recent large increase in membership the Executive still feels that the time is not opportune for the introduction of such a direction. Nevertheless, this matter will be again discussed at a later date.

A recommendation has, however, been given to wholesalers that no licencee whose name is not included in the Bona Fide Register is to receive trade discounts without the prior approval of the Wellington Radio Traders' Association Secretary.

3. Taranaki and Wanganui Areas: The Executive appreciates the action of the Membership Committee in bringing this matter forward and authorizes the Association to write to the Wanganui and to the Manawatu Associations regarding the Taranaki and Wairarapa Districts with a view to ascertaining whether or not those Associations are prepared to take the necessary action to stimulate interest and to obtain as near as possible 100 per cent. membership. If not, the Executive proposes to consider the possibility of enrolling these dealers as country members of the Wellington Association. It was suggested that when writing to these Associations to ask them the extreme radius of any member, as if the proposal is gone on with, this Association would not desire to enrol a member in any town which already has a member belonging to one of these other Associations.

4. Mr. Billing reported on recent activity of the Membership Committee and the appointment of Mr. E. K. Ormrod as representative of the Committee to act as liaison officer to interview dealers and where appropriate to enrol them as members of the Wellington Radio Traders' Association. Remuneration to Mr. Ormrod will be 50 per cent. of the first year's subscription of each new member enrolled by him.

On the motion of Mr. Oxley, seconded by Mr. Young, the Executive approved this appointment.

5. Open or Social Meeting—11th February, 1952, has been tentatively fixed as the date of a meeting to which members and non-members are to be invited. It is proposed that after the formal business has been completed an open forum discussion will be arranged. Quarterly meetings are proposed for the future.

6. The Executive carried a resolution conveying its thanks to the Membership Committee for the outstanding results achieved.

Secretaries of Associations are reminded that reports of meetings, trade notes, personals, and gossip notes for publication, should reach *Radio and Electronics* by the 10th of each month.

A MESSAGE FROM THE WELLINGTON PRESIDENT

Although the following message is addressed to Wellington members, it contains brief comments on so wide a range of subjects that it is published by us feeling that the information will be welcomed by all Federation members and readers generally.

With the approach of the Christmas season and in view of the fact that no recent meeting of members has been held, the Executive thought it appropriate that a letter should go forward to you bringing to your notice one or two points which will be of interest to you. It was deemed inadvisable to hold a meeting close on to Christmas because many traders could not afford the time to attend.

Membership

You will be encouraged to know that the membership of the Wellington Association has now reached substantial figures and we can readily claim that the Association has never been stronger. Over the recent months a large number of new members has been enrolled and this is due in no small measure to the untiring and zealous efforts of the Membership Committee.

Batteries

You will know that the problem of the supply of batteries is one that has been exercising the minds of traders for some considerable time. Our Association, in conjunction with the New Zealand Federation has, however, been watching the matter closely and the problem has not only been brought to the attention of the New Zealand manufacturers, Eveready, but opportunity was taken to make submissions to the Board of Trade.

The supply of the small and portable type of "B" batteries has been the greatest problem and although we know that recent shipments arriving will tend to help to meet marked requirements, we still do not feel the problem is one that can be regarded as being satisfactorily solved.

Supplies in General

The needs of the trade have been carefully watched and while, in common with certain other sections of the commercial community, shortages have been experienced, we feel that as an Association, we lost no opportunity of pressing for supplies when these could be procured. You will know, for instance, that although there has been an acute shortage of dollars, these were made available for the importation of tubes from dollar areas and this will mean that early in the New Year the trade should have available to them a comprehensive range of tubes even though, in many instances, these will show a sharp increase in price.

Trading Conditions

It can be claimed that trading conditions remain buoyant and there is every reason to believe that such

(Continued on page 48)

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Philips Experimenter

(Continued from page 25)

the remaining pair. With any four tubes, there will always be one arrangement of pairs that will give the best balance, and as long as balance can be obtained within the range of the potentiometers, it is possible to proceed with the next part of the adjustment.

Up till now, we have been working only with carrier input, and no audio, so that R_{27} could not possibly affect the situation. All we have done is to properly balance out the carrier from the modulators. Now, however, we set the audio oscillator to about 1,000 c/sec. and turn the volume control R_1 up until some R.F. appears again on the 'scope. This is a demonstration of a carrierless signal, because we have so adjusted things that no carrier appears in the output. The signal we get on turning up the audio input must, therefore, be composed of sidebands only. What now has to be done is to see that one of the sidebands is cancelled out, leaving only the other. If we imagine that this has been done, then, remembering that the audio input is a single frequency, the output must also be a single frequency, and should be indistinguishable on the 'scope from a carrier from an R.F. oscillator. That is to say, it will have constant amplitude, and will not be modulated in any way. But if traces of the second sideband are present, then the output that is obtained when the volume control is turned up will have the appearance of a carrier modulated by the audio signal and its harmonics. This is most likely what will appear when the audio is first turned on, and from there on, all adjustments are aimed at reducing the modulation that is apparent on the output signal. The first thing to do is to adjust R_{27}. If this is turned right down, the modulation effect will be clearly demonstrated, since the pattern will be that of an A.M. wave. This can be done in order to enable the time-base of the 'scope to be set to a frequency that holds the modulation pattern stationary. Then R_{27} is adjusted until the modulation depth is as small as possible. After this, all that remains is to adjust L_1 and C_{28}. All the adjustments described up till now are very easily made, and take only a few seconds each, in spite of the length of the description!

The adjustments of L_1 and C_{28} need to be done according to a fixed plan, otherwise all the fiddling in the world will not get them right. This plan is simply to make a change in L_1, and then to adjust C_{28} for best results. A further change is then made in L_1, and after C_{28} has again been adjusted, it is judged whether the new result is better or worse than the previous one. The reason for this procedure is that it is the *combination* of the two settings that is important. While doing this, remember that the aim is to reduce the modulation showing on the 'scope to as low a level as possible. With the original, constructed in our laboratory and set up just as described above, it was found possible to reduce the residual modulation to a figure of approximately 7 per cent., corresponding to an attenuation of the unwanted sideband of approximately 35 lb.

LISTENING TO THE OUTPUT

As we explained earlier, once a single sideband signal has been generated, it can be detected only by re-inserting the carrier and detecting in the ordinary way. When the gear is on the bench, this can be done without any special equipment at all other than an absorption wavemeter equipped with a pair of phones. The exciting R.F. oscillator is placed on the bench not far from the S.S.S.C. unit, so that if the wavemeter is held about midway between the two, a considerable signal is picked up from both. In this position, the modulating tone is heard "loud and clear," while if the wavemeter is moved so that the only pick-up is from the modulators, all that is heard is a very rough note, comprising harmonics of the modulating frequency. As carrier is re-inserted by moving nearer to the R.F. oscillator, the note clears up as if by magic, and the quality is very good indeed.

R.F. INPUT

After the S.S.S.C. unit has been adjusted, an adjustment can be made of the R.F. input voltage, by varying the coupling to the R.F. oscillator. This will be found to increase the output of the modulators up to a point where further increase of input causes no further increase of output. The best place to set the coupling is just below this point. When adjustment is otherwise completed, the maximum audio input level can be judged by the point at which, as the input control is advanced, the modulation starts to become distorted.

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Letter to the Editor

Sir,—Your November and December issues contain descriptions of "A Flexible Test Instrument," and the very first paragraph of the article in the December issue, page 38, perpetrates a heresy that I cannot permit to pass without the strongest expression of protest.

I quote, "In the amplifier, negative feedback has been avoided because when using the chaser all forms of correction must detract from a faithful recognition of the state of affairs in the equipment under test."

This statement displays a woeful lack of understanding of negative feedback, or else a perversity equalled only by politicians.

If "faithful recognition" is the aim, then the amplifier must not introduce distortion. Negative feedback minimizes amplifier distortion, so this is the very place to apply it. The quoted statement seems to imply that negative feedback over the amplifier would tend to correct distortions present at the checked point, or else would introduce some "tone correction."

This is utterly wrong, of course.

I wonder, incidentally, what sort of "faithful recognition" can be obtained through an eight-inch speaker mounted in a small tin box, with eight holes in the back "for the release of back pressure." Is this not a job for an "infinite baffle," or, better still, moving coil headphones?

And why, now we are at it, was the amplifier not used as part of a valve voltmeter, and also switched to a test oscillator?—Yours faithfully, FEEDBACK.

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TUBE DATA: 884, 885 Thyratrons, Triode Type

The 884 and 885 are grid-controlled, gas-discharge tubes with indirectly heated cathodes. These tubes are designed primarily for use as sweep-circuit oscillators in cathode-ray tube circuits. They feature stability of operation, low deionization time, and the corresponding practicability of operation at frequencies as high as 15,000 or 20,000 cycles per second. The 884 has a 6.3-volt heater and employs an octal base, while the 885 has a 2.5-volt heater and uses a small 5-pin base. For new equipment design, the 884 is the preferred type.

GENERAL DATA

Electrical:

	Type 884	Type 885	
Heater voltage (A.C. or D.C.)	6.3 ± 10%	2.5 ± 10%	volts
Heater current	0.6	1.5	Amp.
Direct interelectrode capacitances:			
Grid to Anode	6	6	uuf
Grid to Cathode	2	2	uuf
Anode to cathode	0.6	0.6	uuf
Tube voltage drop (approx.)	16	16	volts
Physical:			
Mounting position	Any	Any	
Maximum overall length	4 1/8	4 3/16	inches
Maximum seated length	3 9/16	3 9/16	inches
Maximum diameter	1 9/16	1 9/16	inches
Bulb	ST-12	ST-12	
Base	Small Shell Octal 6-pin	Small 5-pin	

Relaxation Oscillator—Sweep-circuit Service*

Maximum Ratings, Absolute Values:

Peak anode voltage	300 max.	volts
Peak cathode current†	300 max.	ma.
Peak grid current‡	1 max.	ma.
Peak voltage between any two electrodes or between any electrode and heater	350 max.	volts
D.C. heater-cathode potential	—100 to +25	volts
Ambient temperature range	—75 to +90	°C.

*For best life results, it is desirable to delay tube conduction for about 10 seconds after applying heater voltage in order to allow the cathode to reach normal operating temperature.

†In sweep circuits designed so that the peak cathode current of 300 milliamperes will not be exceeded during condenser discharge, the resultant average cathode current is so small in comparison with the average-current capability of the cathode that a maximum rating for average cathode current has no practical significance.

‡The resistance of the grid resistor should be not less than 1000 ohms per maximum instantaneous volt applied to the grid. Resistance values in excess of 500,000 ohms may cause circuit instability.

Relay and Grid-Controlled Rectifier Service§

At Frequencies below 75 cycles per second.
Maximum ratings, Absolute values:

Peak anode voltage	350 max.	volts
Peak cathode current	300 max.	ma.
Average cathode current¶	75 max.	ma.
Peak voltage between any two electrodes or between any electrode and heater	350 max.	volts
D.C. heater-cathode potential	—100 to +25	volts
Ambient temperature range	—75 to +90	°C.

§The heater voltage should be applied for 10 seconds before tube conduction occurs.

¶For an averaging period of 30 seconds.

INSTALLATION

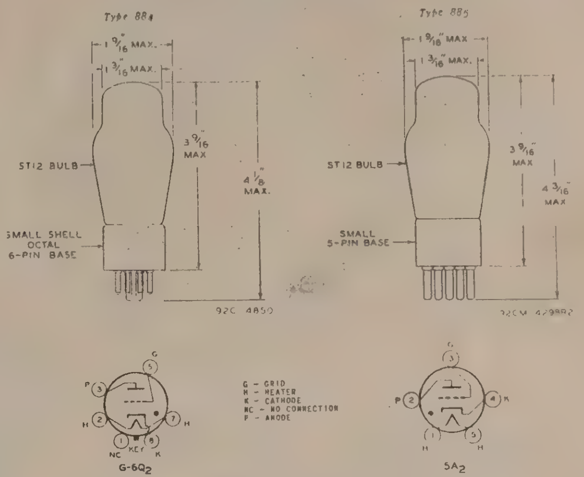
The base of the 884 fits the octal socket while that of the 885 fits the 5-contact socket. The sockets may be installed to hold both types in any position.

The bulbs of these tubes become hot during continuous operation. Adequate ventilation, therefore, should be provided to prevent overheating. Operation is not critical to changes in bulb temperature.

The heater in either type may be operated on A.C. or D.C. The heater voltage for the 884 should not deviate more than ± 10 per cent from the normal value of 6.3 volts. Similarly, the heater voltage for the 885 should be held to 2.5 volts with a permissible variation of ±10 per cent. With either type in rectifier service, the heater voltage should be applied for 10 seconds before anode voltage is applied.

The cathode of either type should be connected directly or through a cathode-bias resistor preferably to the midpoint of the heater circuit. The heater may be made negative with respect to the cathode by a potential difference not to exceed 100 volts, or positive by more than 25 volts.

Dimensional Outlines &
Bottom Views of Socket Connections



The maximum ratings for the 884 and 885 are on an absolute maximum basis. In order not to exceed these ratings in the design of new equipment, which should utilize the preferred type 884, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, or manufacturing variation in the equipment itself.

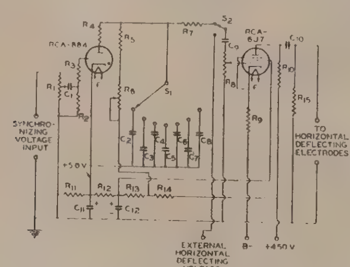
The maximum anode current is the highest current which can be drawn continuously through the tube and is based on the allowable heating of the tube. In grid-controlled rectifier service, the average current should be determined on the basis of operation over a 30-second period. If the cycle of operation during the 30-second period is rapid, the average current can be read on a D.C. meter. If the cycle is long, it is necessary to calculate the average current from readings taken during the 30-second period.

APPLICATION

The 884 and 885 can be operated as sweep-circuit oscillators because they have a characteristic which permits a negative voltage on the grid either to maintain anode-current cut-off or to lose control promptly, depending on the value of the anode voltage. For any specific positive anode potential, there is a critical value of grid voltage, as shown by the curve of Fig. 1. When the grid is maintained more negative than this critical voltage, conduction does not take place and the anode current re-

mains zero. If the grid is made less negative than the critical value, conduction occurs and the anode current assumes a value determined by the applied anode potential and the impedance in the anode circuit. In the conducting condition, the 884 and 885 have a voltage drop which is quite low and substantially independent of both anode current and grid bias. Conduction may be stopped and the grid allowed to regain control by reducing the anode voltage below the ionization potential of the gas in the tubes. This action can be controlled by means of a condenser shunted across the anode circuit and charged through a resistor, as shown in Fig. 2. When the anode voltage reaches breakdown potential, the condenser discharges through the tube, the anode voltage drops, the grid regains control, and a new cycle starts. The shape of the waves produced in this manner resembles the teeth of a saw. This saw-tooth wave is essentially linear and is especially suited for sweep-circuit control of cathode-ray tubes because it permits quick return of the beam to the starting position on the time axis and eliminates or keeps dim the visible pattern of the return sweep.

A practical linear sweep circuit for the generation of saw-tooth oscillations up to about 350 volts, peak to peak, is shown in Fig. 2. In operation of this circuit, whichever of the condensers C_2, C_3, C_4, etc., is connected will charge through resistors R_5 and R_6 until the voltage at the anode of the 884 reaches breakdown potential. Assuming that C_2 is connected in circuit, it then discharges through the 884 and resistor R_4. The purpose of R_4 is to limit the peak current through the 884 to a low



C_1 = 0.25 μF OR GREATER
C_2 = 0.25 μF, 500 V
C_3 = 0.1 μF, 500 V
C_4 = 0.04 μF, 500 V.
C_5 = 0.015 μF, 500 V
C_6 = 0.005 μF, 500 V
C_7 = 0.002 μF, 500 V
C_8 = 0.0008 μF, 500 V
C_9 = 0.5 μF, 250 V.
C_{10} = 0.5 μF, 500 V
C_{11} = 25 μF 15 V
C_{12} = 8 μF, 200 V.
R_1 = 5000 OHM (MAX) POTENTIOMETER
R_2 = NOT GREATER THAN 50000 OHMS
R_3 = 2000–3000 OHMS, 0.5 WATT
R_4 = 350–500 OHMS, 0.5 WATT
R_5 = 0.3–0.5 MEGOHM, 0.5 WATT
R_6 = 1 MEGOHM POTENTIOMETER
R_7 = 1 MEGOHM, 0.5 WATT
R_8 = 0.5 MEGOHM POTENTIOMETER
R_9 = 850 OHMS, 0.5 WATT
R_{10} = 0.1 MEGOHM, 0.5 WATT
R_{11} = 1500 OHMS, 0.5 WATT
R_{12} = 25000 OHMS, 1.0 WATT
R_{13} = 60000 OHMS, 1.0 WATT
R_{14} = 60000 OHMS, 1.0 WATT
R_{15} = 2.0 MEGOHMS, 1.0 WATT
S_1 = 7-CONTACT S.P. SWITCH
S_2 = S.P.D.T. SWITCH

92CM-4875R1

APPROXIMATE FREQUENCY RANGE
(cycles per second)

SWITCH S_1 ON		C_2	C_3	C_4	C_5	C_6	C_7	C_8
R_6 AT	MAX.	20	80	110	280	670	1500	3600
	MIN.	60	130	340	880	2200	4900	11400

Linear Sweep-Circuit Oscillator and Amplifier

value. The saw-tooth voltage developed across the shunt condenser (C_2, C_3, etc.) is higher than that required for the amplifier input. For this reason, R_7 is placed effectively in series with R_8 to comprise a voltage divider. The frequency of the time-sweep oscillator is controlled by means of R_6 and S_1. In general, the more resistance included at R_6 and the more shunt capacitance selected at S_1, the lower the frequency of the saw-tooth oscillations. The values of R_1, R_2, R_3, and R_4 have been selected for greatest stability of operation. The value of R_1 will be determined by the associated circuits. If the value of R_2 is lower than indicated, a proportionately higher value of C_1 may be required.

The A.F. amplifier is conventional in most respects, except that the usual cathode by-pass condenser is omitted in order to improve the overall frequency response. Potentiometer R_8 acts as a gain control so that the horizontal sweep voltage applied to the cathode-ray tube can readily be varied.

For synchronizing and locking-in purposes, an A.C. potential of a few volts (preferably adjustable from zero) is suitable. Any means of introducing this voltage in the grid circuit is satisfactory, provided the total effective external grid-circuit resistance to both alternating current and direct current is in accord with recommended grid-resistor values.

The circuit in Fig. 2 has an approximate frequency range from 20 to 11,400 cycles per second with excellent stability. By suitable modification of shunt condenser and R_6, the frequency range may be extended to 15,000 or 20,000 cycles per second with some sacrifice in stability as the frequency is increased. Under certain conditions, operation at frequencies as high as 60,000 to 100,000 cycles per second has been achieved, but such operation is apt to be inconsistent and unreliable.

In the design of sweep circuits for operation at frequencies above 200 cycles per second, the peak currents and the peak voltages must be reduced as the frequency is increased if satisfactory life is to be obtained.

The 884 and 885 may also be used in grid-controlled rectifier application. When so used, the tubes should be

(Continued on Page 48.)

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	K.16.M	PT.11.M
		PT.29.M

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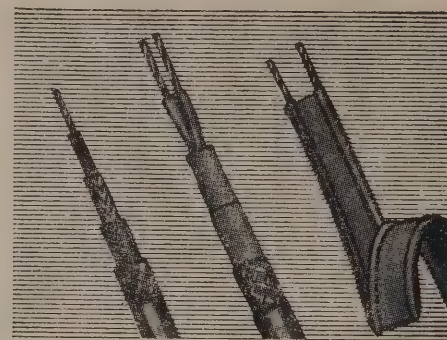

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ANTENNAE AND TRANSMISSION LINES

The design and performance of a dielectric-lens aerial for marine-navigational radar is described. The aerial has a fan beam pattern and is designed for horizontal polarization over the frequency band 9320-9500 mc/sec. Mathematics and principles of operation given.

—*Wireless Engineer* (Eng.), October, 1951, p. 299.

The paper presents a procedure for measuring the dielectric properties of metal loaded artificial dielectrics in the microwave region by the use of the short-circuited line method. Calculations and measurements of the dielectric constant and transmission loss given for a few typical examples.

—*Proceedings of the I.R.E.* (U.S.A.), November, 1951, p. 1389.

AUDIO EQUIPMENT AND DESIGN

A scratch filter with a continuously variable cut-off point. Some type of cut-off is necessary to reduce the "hiss" present in certain recordings and the circuit described will doubtless do the job although the components may not be easy to obtain.

—*Audio Engineering* (U.S.A.), November, 1951, p. 6.

The old controversy regarding pentodes and triodes for the output still rages and here is described what is called an ultra-linear amplifier which is intended to give the pentode the advantages of the triode whilst retaining its advantages. The idea relates to the energizing of the screen grid from a transformer coupling, and is well worthy of experiment.

—*Ibid*, p. 15.

Something new in remote amplifiers the purpose being a "remote" which will look after itself. The power is fed over the 'phone line which makes for simplicity and the operator can be sure of what his distant amplifier is doing.

—*Ibid*, p. 18.

It is unfortunate that horn type speaker systems are out of the high quality realm in all but theatre productions, as exponential baffles are often the most satisfactory answer to the speaker problem and folded forms can be used to save space. A thorough discussion of various types of horns.

—*Ibid*, p. 24.

CIRCUITS AND CIRCUIT ELEMENTS

One of the most welcome developments of the modern communications receiver is the type of noise limiter which adjusts its threshold. It is not necessary that such should be based on diode detectors but can be used with biased detectors and can be adapted to any set with such a detector. There is room for interesting experimenting in this article.

—*Radio and Television News* (U.S.A.), October, 1951, p. 46.

ELECTRONIC DEVICES

Here is a design of a toy electronic organ made from junk box parts. It would make a most interesting toy for a child and also the experimenter). It covers a complete octave and one might be able to extend the ideas with some ingenuity.

—*Ibid*, p. 57.

Methods of obtaining high voltages are very necessary these days. The old method of charging condensers in parallel and then connecting them in series is used in what is referred to as an electrostatic D.C. transformer. The discontinuous process is transformed into a continuous one and gives a steady output current.

—*Wireless Engineer* (Eng.), October, 1951, p. 291.

MATERIALS, VALVES, AND SUBSIDIARY TECHNIQUES

The news of the year is undoubtedly in relation to transistors. Those watching the development of these devices have been aware of their great possibilities. The new n-p-n junction transistor is made in sandwich form which eliminates cat-whiskers, shows lower noise, better stability, higher gain and high power-handling capacity. Reliability and low power consumption permit new large scale applications now beyond the range of vacuum tubes and open a new era for electronic development.

—*Electronics* (U.S.A.), November, 1951, p. 83.

Secondary electron emission is of great importance to the physicist because of its bearing upon the problem of the interactions between fundamental particles and to the radio engineer because of its applications. A complete theory does not exist, but the paper throws much light on the phenomenon.

—*Proceedings of the I.R.E.* (U.S.A.), November, 1951, p. 1367.

A study of crystal diodes in modern electronics. The fundamental design characteristics of germanium crystal diodes—design and construction—a table of commercial types in the U.S.A. with notes on characteristics and ratings.

—*Radio and Television News* (U.S.A.), October, 1951, p. 47.

MATHEMATICS

The impedance of a two-terminal network is defined completely by the insertion loss and phase shift it produces when inserted between known sending and receiving impedances. Reactive and resistive impedance components are read directly from a simple graphical chart in which frequency is not a parameter.

—*Proceedings of the I.R.E.* (U.S.A.), November, 1951, p. 1393.

A universal equalizer chart. A modification of the familiar Smith chart consolidates on one time-saving plot all positive value solutions to the two general equations for series shunt and bridged T audio equalizers.

—*Electronics* (U.S.A.), November, 1951, p. 132.

Network design charts. Time-saving universal T, pi, and L network chart covering all normally encountered phase shifts and transformation ratios.

Ibid, September, 1951, p. 132.

RECEIVERS

The paper deals with the tracking of superheterodyne receivers, the choice of tracking frequencies, the tracking error curve being determined by the tracking frequencies and the I.F. It deals also with the calculation of the inductance and the capacitances in the oscillator circuit.

—*Wireless Engineer* (Eng.), October, 1951, p. 305.

A design for a FM receiver—simple inexpensive set for the 90 mc/sec. band. The design was evolved to ascertain if an inexpensive set could be made comparable with A.M. sets. Construction details and components given.

—*Wireless World* (Eng.), November, 1951, p. 441.

A sensitive T.R.F. receiver. This is a three-valve receiver which uses an amplified A.G.C. circuit. The performance of the receiver compares very favourably with a 3-valve superhet. The selectivity is inferior but the design should be very interesting to the N.Z. amateur.

—*Ibid*, p. 452.

ELECTRONIC DEVICES

Of all the troubles in the TV set the worst are caused by motors which make "blobs" on the screen. The article deals not with a remedy on the automobile but an improved form of limiter circuit for the TV set.

—*Wireless World* (Eng.), November, 1951, p. 451.

A power stroboscope has been developed for high speed flash photography at picture repetition rates from 100-4,000 pictures/sec., the duration of each flash being 5 microseconds. The control circuit uses a hydrogen thyratron to trigger the tube discharge. Such devices are the basis for high-speed photography in England.

Proceedings of the I.E.E., Part II, October, 1951, p. 619.

An image converter has been used as a shutter mechanism for exposure durations of less than 1 microsecond. The electron emission from the photo cathode is controlled by suitable electrode potentials and the fluorescent image formed during the exposure interval is recorded photographically.

—*Ibid*, p. 635.

Description of a miniature radar transpondor beacon. The azimuth range and identification of a pilotless plane equipped with radar beacon can be determined. The beacon transmits a reply automatically when interrogated.

—*Electronics* (U.S.A.), September, 1951, p. 104.

In connection with a programme of research on muscular contractions, currents ranging from a fraction of an ampere to as high as 6 amps were required. The apparatus provides stimulating pulses through an electrolyte using paralleled triodes for the high current required.

—*Ibid*, November, p. 115.

A storage system which will store binary pulses has been constructed. Pulses are stored in tubes in a square array of discreet spots of charge and each spot may assume one or more of two possible potentials and the system may be used to compress, expand, or delay a group of pulses.

—*Proceedings of the I.R.E.* (U.S.A.), November, 1951, p. 1413.

INSTRUMENTS AND TEST GEAR

In the paper it is shown how the electric and magnetic polarization of an aperture may be determined accurately by electric analog measurements. A special electrolytic cell is used giving much easier results than mathematical methods.

—*Ibid*, p. 1416.

A microwave generator with crystal control. A portable 3,100 mc/sec. signal generator with pulsed or C.W. output is useful for the field testing of radar and beacon receivers. Substituting crystals in two channels gives up to 6,000 mc/sec. frequency range without changing other circuit components. The instrument is light and has accurate frequency calibration.

—*Electronics* (U.S.A.), November, 1951, p. 93.

One of the most versatile instruments in the laboratory is the Q meter. It is capable of measuring a wide variety of circuit constants including R.F. resistance and reactance. The paper proposes a means of extending the resistance and reactance range of the Q meter with transformers the primaries being connected to the meter and the secondaries to the unknown impedances. A description of the transformers and charts for use are given.

—*Ibid*, p. 129.

TRANSMITTERS AND TRANSMITTING

All transmitters have different keying requirements and it is difficult to find a method universally successful. The author has constructed a vacuum tube keyer with a simple circuit which is stated to have responded beautifully to all tests.

—*Radio and Television News* (U.S.A.), October, 1951, p. 51.

TELEVISION

In the U.S.A. with the broadcasting of colour programmes many experimenters are constructing converters and the article deals with the colour wheel and methods of keeping it revolving at exactly the right speed.

—*Ibid*, p. 43.

It has now become standard practice to derive the E.H.T. supply for a television receiver from the line flyback, but another system is the "ringing choke" which also depends on the interruption of current in an inductance. The basic circuit and waveforms are given and certain advantages which the system possesses.

—*Wireless World* (Eng.), November, 1951, p. 445.

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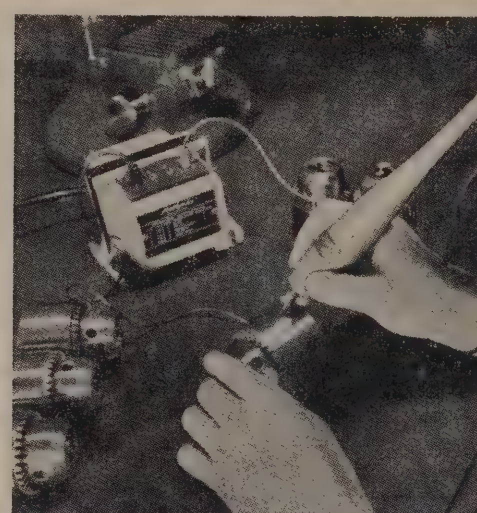

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SHOES and SHIPS

"The time has come," the Walrus said
"To talk of many things. . . ."

By Special Arrangement with the Walrus

A.M. Versus F.M.

A subject of such a controversial nature as this might be well left alone; however, as so much has already been written about it a little more in non-technical vein cannot do much harm. When Frequency Modulation was first loosed upon the public some very extravagant claims were made for it and a number of conclusions drawn which did not apply to F.M. alone.

Then again, the conditions of use have a considerable bearing upon which is the most useful method of transmission—whether it is to be used for radio telephone communication purposes or for entertainment only.

When American F.M. stations first started operating they were pushed up into the high frequency band where they could take up plenty of band space without unduly affecting anybody, and this, at one stroke, conferred two great advantages—a certain freedom from noise which is not nearly as bad at high frequencies, and a chance to broadcast some high fidelity material without having to worry about clipping the top frequencies of the audio signal such as was necessary with amplitude modulation transmitters.

Consequently, when the two systems were demonstrated side by side by enterprising salesmen, who either could not or did not attempt to explain the difference, the idea gained ground that F.M. conferred some magical advantage that A.M. never could provide.

Now every radio enthusiast, and even those who make their living at the game know that in order to preserve valuable band space every station on the broadcast band is limited to a 10 kc/sec. channel. This means that the top audio frequency which may be transmitted is 5 kc/sec. —the sum and difference frequencies about the carrier frequency occupying the full allowable 10 kc/sec. Now if nations did not insist on being heard and band space was plentiful, the channel width per station might conceivably be increased to 30 kc/sec. This would mean that A.M. stations could transmit up to 15,000 cycles of audio frequency and the difference in quality would be startling—provided, of course, that receiving sets were designed to accept the full frequency range and did not have to consider selectivity too much. Most I.F. channels in average receivers these days are quite seriously down at 4,000 cycles!

If the operating wavelength could then be shifted up to the high frequency band, where a lower noise level can be expected, the advantages supposedly peculiar to F.M. are not so evident.

In the field of radio-telephone communication this latter point is most important for in the V.H.F. band, particularly for mobile use in built-up areas where industrial electrical interference is high, the ability to discriminate between noise and signal is everything. The A.M. equipment fitted with efficient noise limiters can acquit itself very well indeed, although F.M. sets are at their best under these conditions. In so far as mobile radio telephone itself is concerned, A.M. equipment has one great advantage in that it is very stable and will continue to give good results under conditions of very rough usage such as can be encountered in many commercial vehicles. Should, for some reason, something happen to reduce the sensitivity of the set it is still capable within reasonable limits of giving some sort of results and anyway such faults as may occur are readily rectified without the use of special equipment. Also the principles involved are better understood by the average radio serviceman who is thus in a position to carry out repairs using only his standard workshop equipment. As against this we find F.M. gear is critical of adjustment, requires special service instruments, and must be kept always at the peak of its performance, otherwise results will deteriorate rapidly. These factors appear to have weighed heavily in favour of A.M. since all the major radio telephone installations in the world (outside America) have adopted A.M. equipment.

From the entertainment point of view, where broadcasting to the public is concerned, F.M. confers definite advantages at the transmitting end, particularly with regard to the cost of transmitters. However, as domestic F.M. receivers are more complicated, and consequently more expensive, the benefits are rather doubtful. It must also be borne in mind that there is no F.M. equivalent of the humble crystal set or one or two valver. Let us not jeer at these headphone hermits, for one presumes they pay their radio licences and are entitled to their pleasure. Those who hide their catwhiskers or tickler coils under the pillow and use the wire of the bed as an aerial needn't get smug about it either for they'll have a restless night with an F.M. set tucked under the pillow!

More seriously, however, the B.B.C. is at present engaged in conducting tests on very high frequencies of both A.M. and F.M. transmissions. So far no announcements have been made as to which system they intend to adopt, but the outcome and their reasons for selecting a particular one will be followed with great interest by many people.

However, come what may—A.M., F.M., pulse modulation, or television, we presume the radio serviceman's back will get just a little more hunched and the hair (if any) a little greyer—he should be easy to recognize, please treat him kindly!

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TRADE WINDS

COLLIER AND BEALE LTD. CELEBRATE SILVER JUBILEE

The 14th December, 1951, saw about 100 guests, in one way or another connected with the ramifications of the Collier & Beale, Ltd., organization, assembled to mark this turnstile of 25 years. The object of this function, said Mr. P. C. Collier, the Managing Director, was to pay tribute in some small way to the many business connections of his company, but for whose co-operation the successful trading over 25 years could not have been achieved. He specially mentioned Mr. E. H. R. Green, Chief Engineer of the Post Office, with whom his early associations had largely paved the way for his company's development—particularly in the field of special equipments. Referring to the manufacture of early receiving sets, his first major production was twelve tuned radio frequency receivers for Messrs. Thos. Ballinger, Ltd., Victoria Street, through the then manager, Mr. C. J. Ralph. From that beginning of 12 sets per month, the organization of Collier & Beale, Ltd., had grown to 1100 sets output per month.

Of his colleague, Mr. Gordon Beale, no words of his could adequate express his high regard for so loyal a partner. He could, continued Mr. Collier, quote many others by name, who had so ably assisted him in various ways, such as his bankers, the Broadcasting Service, the Post and Telegraph Department, the Radio Traders and the Radio Manufacturers' Associations, the several distributors for his company's products, and the various traders generally, so many of whom he was pleased to see at the function.

Mr. W. B. Clarke of H. W. Clarke, Ltd., spoke in eloquent strain of the high esteem in which Messrs. Collier & Beale, Ltd., were held in the radio industry and wished them continuous success.

Mr. E. H. R. Green spoke of his early associations with Mr. Collier and of the splendid co-operation his company had rendered to the several Government Departments in development work.

Many pioneers of the New Zealand radio industry were present, including C. G. Camp, of N.Z. Employers' Federation and first Registrar of Radio Servicemen's Examinations; C. J. Ralph (retired); G. Robertson of A.W.A.; Will Bishop, popular radio entertainer; Ralph Slade; A. C. Jensen, and J. M. Gifford who started one of the earliest radio colleges.

Friends of the former Managing-Director of N.E. & E.Co., Ltd., Mr. Nelson Jones, will be happy to know that he is greatly enjoying getting acquainted with Southern Rhodesia.

Having purchased a car, he has been cruising around the territory, sizing-up the hippopotami, crocodiles, and other game in their natural haunts, preparatory to aligning some of them with his rifle sights. He has already shot a green snake, but makes no reference in his letters to pink elephants!

He reports that at Beit Bridge—on the Southern Rhodesia-Union of South Africa border—a Union Government official, having examined his New Zealand passport, handed it back with the suggestion that he "buy a book on how to play football!"

* * *

As part of their policy of expansion, Russell Import Company have appointed Mr. J. W. Ramsden as Sales Manager.

Jack will have the best wishes of many radio and electrical traders on his appointment. He was well known in the Wellington district until twelve months ago as Russell Import Company's Field Representative and more recently has occupied the same position in the South Island. He now comes back to Wellington to take up this new appointment, which besides being a further step up the ladder, will mean that he will be in contact with a much broader section of the trade, and will be renewing many of his old acquaintances.

* * *

Mr. Peter Proctor, a relatively new arrival from the Old Country, but no stranger to the radio trade, has been appointed South Island Field Representative. In order to get a bird's eye view of New Zealand, he took up aerial top dressing in the country districts, but the call of the trade was too much and once again he finds himself lined up with radio.

* * *

W. (Bill) R. Cooke, who for the last 17 years has been with Cory-Wright and Salmon, Ltd., has retired. Well known throughout the electrical field in which he has been connected for over 30 years, Bill deserves his retirement from work well and truly done. As Mr. C. W. Salmon, Chairman of Directors of Cory-Wright and Salmon, said at a farewell function to him, "his outstanding qualities of courtesy and helpfulness to customers had contributed greatly to the good reputation which the firm enjoyed today and had also made for harmony among the members of the staff.

NOW AVAILABLE!

DECCA MODEL XMS PICK-UPS WITH INTERCHANGEABLE HEADS

★ Automatic Weight Compensation
★ Self Switching of Compensator Circuits
★ Balanced Output Voltages between Standard and Long-playing Heads
★ Unchallenged Performance.

ALL THIS! AND DIAMOND STYLUS FOR STANDARD SPEED RECORDINGS—IF REQUIRED

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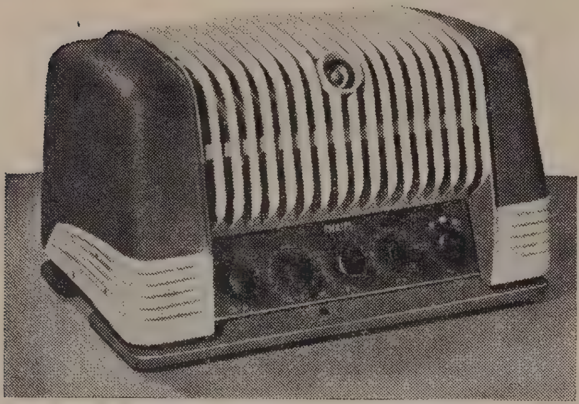
P.O. BOX 1284 104 FEATHERSTON STREET, WELLINGTON TELEPHONE 43-314

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. Advertising rates are charged according to space occupied. For further particulars contact Advertising Manager, R. and E., Box 8022, Wellington.

PHILIPS' NEW 70-WATT AMPLIFIER TYPE EL6420



This is the most versatile of all amplifiers at present on the market. Pleasing appearance and high quality is not likely to be surpassed for many years to come. Moreover, this amplifier offers entirely new possibilities for the most divergent installations, owing to its being equipped with—

★ A special mains switch with stand-by position:

★ A limiter which suppresses instantaneous peaks and thus prevents overload distortion.

★ Adjustable, supplementary volume controls for avoiding acoustic feedback:

★ An output transformer adjustable for 100v as well as for 70v. and 50v. matching system.

Limiter The limiter can be switched on or off with the switch underneath the control panel. It comes into operation as soon as the input signal exceeds a definite value, reducing the gain according to the strength of the input signal, so that the output signal remains practically constant at its maximum value and the harmonic content does not perceptibly increase.

The limiter is specially intended for speech reproduction; upon its being switched on, the treble notes are accentuated, thus increasing intelligibility.

Automatic Fading Out: When the amplifier is fed simultaneously with an input signal (*e.g.,* a microphone signal) which puts the limiter into operation and another input signal (*e.g.,* a pick-up signal) which does not put the limiter into operation, then both signals are equally attenuated by the limiter. Consequently, when one speaks into the microphone during gramophone reproduction, the music is automatically attenuated to background level, and when one stops speaking the music is rapidly restored to its original level.

Volume Indicator: The electronic indicator makes it very easy to obtain a constant sound intensity and to avoid overload due to excessive input signals.

Fine Adjustment of the Sound Intensity: Microphones which are spoken into at a very short distance sometimes give so high a voltage that the normal volume controls can be only slightly turned up. This difficulty can be avoided by turning down the supplementary volume controls.

Avoiding Acoustic Feed-back: There is no risk of acoustic feed-back if the supplementary volume controls are turned down so far that in the maximum position of the normal volume controls this phenomenon is just precluded.

TECHNICAL DATA

Maximum power output	70w
Frequency response curve	30–15,000 c/sec. ± 2 db.
Average hum level for:	
Microphone reproduction	—56 db.*
Pick-up or radio reproduction	—66 db.*
Power consumption:	
Without signal	145w.
With music signal	average: 190w.
With limiter	max. 260w.
In stand-by position of mains switch	100w.
70w.	110, 125, 145, 200, 220,
Mains voltages	and 245v.

This amplifier has been constructed for the most intensive use under the most severe conditions. It is easy to handle and perfectly safe.

*These values have been measured with volume controls fully turned up and they have been corrected for ear sensitivity. With volume controls partly turned up the hum and noise levels are considerably lower.

Address all inquiries to Philips Electrical Industries of New Zealand, Ltd., P.O. Box 2097, Wellington, P.O. Box 2268, Auckland, P.O. Box 861, Christchurch, P.O. Box 143, Dunedin.

* * *

CLEARCALL—THE MODERN INDUSTRIAL COMMUNICATION SYSTEM

Some progressive industrial concerns are still using intercommunication equipment basically similar to the earliest telephones, and others a loudspeaker system built up from public-address components, not designed for the arduous requirements of modern industry. As a result, intelligibility and dependability have been of an inferior order. The BTH "Clearcall" system has been specially designed for industrial applications as a result of many years' experience in the design and manufacture of every kind of sound-reproducing apparatus.

"Clearcall" will operate satisfactorily in dusty, inflammable, acid or alkaline atmospheres, at high or low temperatures and humidities.

Write to The National Electrical and Engineering Co., Ltd., Wellington for publication AG949.

THE "ULTIMATE" CONVECTOR CUPBOARD HEATER

The illustration here shows an outstanding and compact space heater designed essentially for linen cupboards, airing cupboards, tea towel racks, etc.

Operating on very low wattage, the Cupboard Heater is extremely economical, consuming only one unit of power in every eight hours' use, yet by the employment of the principle of convection the whole of the air is warmed and circulated very efficiently. This means low temperatures and small operating costs. The air in a cupboard is not warmed therefore in one spot only but cooler air is drawn in at the bottom of the heater, warmed, and forced out through the apertures at the top. Thus a fan heater effect is achieved.

There are no exposed elements in the heater, hence fire and electric shock hazards are eliminated. The heater has a simple 3-point mounting with $1\frac{1}{8}$ in. clearance between the back of the heater and the mounting wall. Finish is hard wearing pastel green enamel.

The Ultimate Convector Cupboard Heater carries 12 months guarantee and orders are now being taken for immediate delivery.

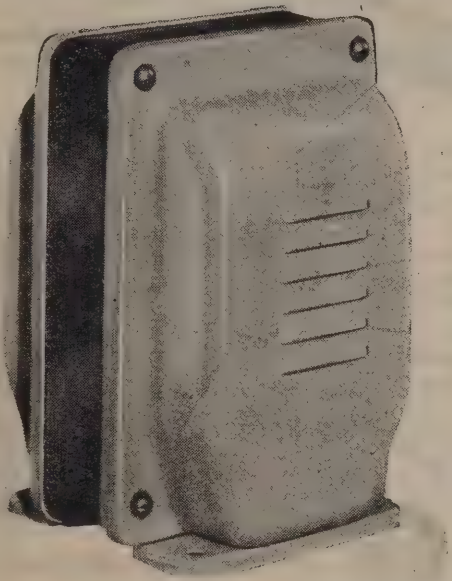
Retail price, 39s. 6d. (includes plug and flex), freight paid.

* * *

COIL WINDING MACHINES

Many electrical appliance, radio manufacturers and servicing companies are using "Douglas" and "Macadie" Coil Winders, made by the Automatic Coil Winder and Electrical Equipment Co., makers also of the popular "Avo" testing instruments. "National Electric" will be pleased to discuss with you your coil winding needs.

A new development is the Douglas Double Bank Multi-winder, ideal for the mass production of small coils so necessary in the radio and allied trades. Up to twenty-four coils may be wound at one time, and the machine is entirely automatic in its action, even to the extent of inserting the interlayer paper insulation.



RELIABILITY
IS IMPORTANT!

Our Transformers and Chokes—wound to your own specification—have a deservedly high reputation for reliability maintained by skilled craftsmen using the finest materials.

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REWINDS—Our rapid reliable service has proved a blessing to servicemen.

•

Price is important, too. Our efficient methods produce reasonable prices.

WISEMAN ELECTRIC COMPANY LTD.

85 VIVIAN STREET
WELLINGTON

Auckland District Representative:
WALDO HUNTER, P.O. Box 2352

PHONE 55-272
P.O. BOX 2020

Proceedings of the New Zealand Electronics Institute (Inc.)

HEADQUARTERS NEWS

There has been very little activity in so far as Headquarters is concerned, due in the main to the fact that most offices were closed over Christmas and New Year and it has not been possible to arrange for consideration of matters that have arisen. It is hoped, however, to have some information available for members from Headquarters in the March issue of the proceedings.

BRANCH ACTIVITIES

Christchurch

Just before the year closed in 1951, approximately seventeen members and three visitors attended a meeting held in the Electrical Lecture Room of Canterbury University College. Mr. R. J. Dippy, a visiting Council member from Wellington, brought greetings from the Wellington Branch to the Christchurch Branch and gave a technical talk on phase shift oscillators and, in particular, the sponge locked oscillator. He later gave a most interesting address on the Decca Navigator and various medium frequency radio aids to navigation with particular reference to New Zealand conditions.

Wellington

During the latter part of November, Wellington Branch had a very busy time, holding three meetings during that month. Mr. Glassey gave a lecture on the subject of super-regenerative receivers. The address ended in questions and answers held on the subject during which several members explained their ideas on the blackboard. Following this lecture, at a later date in the month, a greater portion of the first and the third reels of the lecture was played back to the committee. It was generally agreed that the lecture was not suitable for distribution because of association of the spoken word with circuit diagrams which would have to be reproduced. The following procedure was then laid down:

1. A stenographer would "take off" the lecture from the tape.
2. The speaker would listen to the recording and follow his lecture with the typed script. He would then be able to suitably amend the script and add references, circuit diagrams, etc.
3. This will then be produced as a Paper.
4. The speaker would then be in a position to read his lecture on to the tape recorder and this second recording, together with copies of the circuit diagrams, could be circulated to other centres.

New Secretary—Would members please note that Mr. B. S. Furby has now taken over the Secretaryship of the Wellington Branch and his address is C/o 2ZB, P.O. Box 6166, Te Aro, Wellington.

Auckland Branch

Arrangements are in train for Council members at a later date in 1952 to pay a visit to Auckland Branch with a view to interesting active members in Auckland in the affairs of the Institute. Further advice regarding this proposed visit will be published in these pages shortly.

WELLINGTON BRANCH PLANS PROGRAMME IN ADVANCE

During the current year, the Wellington Branch of the Institute has been fortunate in that it has been possible, by virtue of some concentrated work on the part of the committee, to plan the bulk of the year's programme in advance. In fact, a folder has been issued to branch members showing the dates of the monthly meetings, and in most cases, the programme arranged for those dates. In previous years, when the meeting plaec varied owing to the difficulty of booking a suitable lecture room sufficiently in advance, this wuold not have been practicable, but now that the branch is more fortunately situated in this respect, a planned programme has become a practical proposition. In order that members may keep the meeting nights free, a system has been instituted whereby meeting notices are sent out well in advance of the due date, and these are followed up by

Write 'phone or call the Sole N.Z. Agents

STANDARD TELEPHONES & CABLES PTY. LTD.

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a reminder card a few days before the meeting. These measures, together with the excellent programme of lectures and discussion evenings that have been arranged, have resulted in considerably increased attendances over the last several months.

Plans are under way for a social evening, to be held later in the year. This is to include a number of electronic novelties which are being orangized by Mr. K. Salmon. Any branch members who have not heard of this scheme and who would be prepared to assist in building some of Mr. Salmon's amusing or mystifying electronic "gadgets" are asked to communicate with him or with the Branch Secretary, whose address is given elsewhere on this page.

CLASSIFIED ADVERTISEMENTS

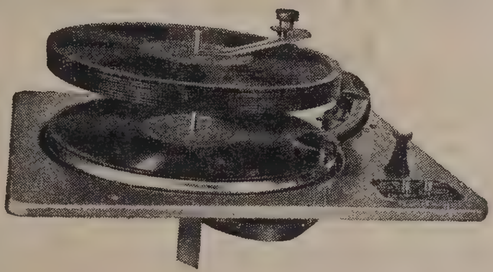
FOR SALE—Brierley Ribbon Pick-up, new, unused. £9. Write "Pick-up," 61 Victoria Street, Lower Hutt.

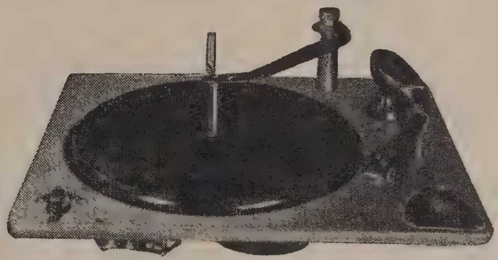
WANTED TO BUY.—Avo wide-range signal selector A.C. or Philips oscillator GM2883 or GM2884. Please state condition of instrument and price. Write M. H. M. de Valk, Factory Hostel, Ngatea, Hauraki Plains.

FOR SALE—Dumont 6 Oscilloscope. Linear hard valve time base, vertical amplifier 5 in. tube, etc., £17 10s. Radio City 20,000 ohm per volt multimeter as new, £15. C. & B. B.F.O., 20–20 kc., £15. Fisher, 8 Blythswood Flats, Willis Street, Wellington. Phone 51-949.

Collaro QUALITY PRODUCTS

STOCKS IMMEDIATELY AVAILABLE





The Collaro RC500 Record Changer

A brilliant automatic record changer, specifically designed for simplicity and reliability. Plays nine 10 in. or nine 12 in. records. Incorporates spring suspension, which eliminates acoustic feedback. And it's foolproof against jamming.

Available with a choice of pick-up including magnetic, crystal, and high-fidelity models. Both models suitable for A.C. supplies only.

The Collaro 3RC511 Record Changer

A completely automatic three-speed changer designed to "take all records"! 3RC511 plays $33\frac{1}{3}$, 45, and 78 r.p.m. records with a minimum need for adjustments. Fitted with pick-up arm, suitable for all types of Collaro plug-in heads. Beautifully made and completely foolproof.

Available complete with twin G.P.27 plug-in heads, one for standard recordings, the other for long-playing discs, thus ensuring quality production.

Sole New Zealand Distributors:

RUSSELL IMPORT CO., LTD.

BOX 102, WELLINGTON

Radio Roundabout

The "Standard" High Frequency Spectrometer

The High-frequency Spectrometer, manufactured by Standard Telephones and Cables, Ltd., made its debut during the war years. It was not until after the war that it became widely known as a complex waveform analyser with an exceptionally high resolving speed, capable of analysing the whole of the frequency spectrum 6.4 kc/sec. to 4 mc/sec.

The latest model of the instrument employs a 6 in. cathode ray tube, on the screen of which a visual indication is given of both the frequency and the amplitude of the components of a complex waveform. The display on the screen is arranged as a number of vertical lines; the frequency of each component being indicated by its horizontal position while the amplitude is directly proportional to the length of line traced. Permanent records can be obtained by the use of either still or cine cameras.

The instrument analyses a complex waveform by first amplifying the waveform and then applying it to 27 band-pass filters in parallel, spaced at three octaves over a range of nine octaves. Individual filters transmit frequencies present in their pass bands, and apply them to a rectifier valve associated with each filter. The D.C. output from these rectifiers is stored in reservoir capacitors, which are scanned in turn by a high-speed rotary switch. The switching circuit applies the D.C. voltages to a converter circuit, which supplies half-wave alternating current to the vertical plates of the cathode ray tube, causing the beam to trace a vertical line. Simultaneously, the horizontal plates are supplied with a D.C. potential from the rotary switch, which causes the beam to move to a predetermined horizontal position. Each filter is allocated a specific horizontal position for the beam on the tube screen, and the adjustment of the switch-gear is such that the vertical plates are energized by one particular filter only when the beam is in the horizontal position identified with that filter. Therefore, if a frequency is present in any particular filter, a vertical line will appear in the appropriate position on the screen. The spacing of the lines is arranged in groups of three and four to facilitate identification.

A switch connected to the storage capacitors determines the charging and discharing times of the D.C. storage circuit associated with each filter, and thus enables the duration of the display of a transient on the screen to be set to either of two values. The display produced by a steady waveform will, of course, appear steady on the screen, as the storage capacitors are scanned continuously by the rotary switch 23 times per second.

The instrument operates from 220/240 volts, 40-60 c/sec., A.C. supplies, and an auto-transformer is available to enable it to be operated from other voltages.

* * *

SECOND BRITISH PLASTICS EXHIBITION AND CONVENTION ARE PLANNED FOR 1953

To meet the wishes of an overwhelming majority of those who took part in the first British Plastics Exhibition and Convention at Olympia, London, in June, 1951, it has been decided to hold a similar exhibition and convention in 1953, the exact dates to be announced later. The exhibition and convention will again have the full support and co-operation of the British Plastics Federation. Organizers are "British Plastics," Associated Iliffe Press, Dorset House, Stamford Street, London, S.E.1.

* * *

VARIABLE TRANSFORMER GIVES SECONDARY VOLTAGE

The regulating of the intensity of illumination for shop windows, stage lighting, and similar displays, calls for a simple and highly-efficient apparatus. A London electrical firm has produced a range of variable transformers, built on the auto-transformer principle, to meet these requirements.

With these transformers, which are fitted with a graduated scale and a knob, a secondary voltage can be obtained that is variable from zero to two per cent. above the nominal primary voltage. The efficiency is high, the graduated scale permits exact regulation to the fraction of a volt, and owing to the low voltage loss there is constant regulation.

These variable transformers also have a wide field of application in research, testing, and repair departments. In combination with valve rectifiers they can quite easily be used to give an efficient and continuously variable direct current supply unit.

First TV Station in Argentina Equipped by FTL

The complete television broadcasting station ordered by Radio Belgrano y Primera Cadena Argentina de Broadcastings, S.A., Buenos Aires, from the International Standard Electric Corporation is the first to be installed in Argentina.

Completely equipped by the Federal Telecommunications Laboratories, the station features a 5 kw type FTL-19A transmitters operating on channel 7 into an 8-bay FTL-23A antenna, providing an effective radiated power of 45 kw. The transmitter, installed in the Ministerio de Obras Publicas building, receives both the sound and picture programme from the studio, over an FTL-27B studio-to-transmitter link. The studio facilities are installed in the Alvear Palace Hotel building, three km. from the transmitter.

Studio facilities include two complete studios, each with three cameras, de luxe microphone booms and camera dollies, and independent control rooms. Two 35 mm. and two 16 mm. motion picture projectors are installed in the film studio. These operate into a single iconoscope film chain which can be aligned for use with any of the four film projectors by means of optical multiplexers and a rail assembly over which the iconoscope camera can be rolled. The rail assembly is equipped with index stops for semi-automatic alignment of the iconoscope camera with the projectors.

An FTL-93A Poly-fex Scanner is furnished for the film studio to be used as a special effects and video switching centre. The FTL-93A supersedes the FTL-82A dual flying spot scanner and permits manual and automatic fading, montage effects, lap-dissolves, and switching among four channels. Two internal flying spot scanner channels for slides and special effects are furnished with the equipment and the other two channels come from the studio, film, or remote programme, for mixing with the slide channels.

A mobile pickup unit is provided which is designed for television remotes at outside sports events, parades, etc., or wherever the nature of the programme does not justify the installation of fixed facilities. This "telecruiser," therefore, will be invaluable in providing the station with a wide variety of programmes, particularly sporting events and should contribute in large measure to sustaining viewers' interest. The telecruiser is furnished basically with three cameras, one of which is fitted with a variable focus Zoomar lens, and a portable SHF link, for relaying the video and aural programme to the studio.

The "heart" of the master control room at the studio is the FTL-89A master switchboard, arranged for switching six inputs among six outputs. The inputs may be comprised of a combination of the programmes coming from the two live pickup studios, film studio, the remote programmes, and the slide channel from the Poly-fex scanner. The outputs may be "channelled" around the station depending upon programme requirements, but a typical arrangement is one output to transmitter, one for previewing, one for feeding back into the studio being used for rehearsal and two for insertion into the FTL-93A Poly-fex scanner for special effects.

Another mobile pickup unit, not used for furnishing programmes to the studio, is provided. This unit is used for demonstrating over a closed circuit television transmission and reception to the public and includes two cameras, control equipment, and a variety of coaxial cable and TV receivers. The vehicle is entirely self-contained and includes an air-conditioner and A.C. power generating equipment.

The station is now on the air and went into full operation on October 17, 1951.

•

New R.I.C. Specifications Issued

From the Radio Industry Council, London:

Sections 1 and 2 of the following specifications:
No. RIC/142—Capicitors, variable, preset, air dielectric.
No. RIC/143—Capacitors, variable, preset, mica dielectric..

These Specifications have been produced by agreement between B.R.E.M.A., R.C.E.E., and R.E.C.M.F. whose individual contributions to the substance of the documents have been co-ordinated and edited by the Technical Specification Committee of R.I.C. and have been authorized for publication by the Technical Directive Board of R.I.C., on which all the constituent associatons of R.I.C. are represented.

For the time being these Specifications are meant for use internally within the industry, but it is intended to submit them in due course to B.S.I. It is hoped that by the time that stage has been reached, it may have been possible to co-ordinate the respective requirements of the industry and of the Services for these components in comprehensive national standards.

Further copies of these Specifications may be obtained on application at the above address. The price of Sections 1 and 2 of RIC/142 together is 7s. 6d. per set (post free) and the price of Sections 1 and 2 of RIC/143 together is 5s. per set (post free).

When Sections 3 of RIC/142 and RIC/143 are available, they will be charged for separately and their price will be announced when they are issued.

Section 3 of Specification No. RIC/131—Capacitors, Fixed, Paper Dielectric, Tubular Foil.

With the first and second sections already published, this makes Specification No. RIC/131 complete.

In each case where extra copies of Sections 1 and 2 of this Specification have previously been purchased from R.I.C., the appropriate number of copies of Section 3 required to make the Specification complete will be sent to the purchaser without further charge. This will be done automatically by R.I.C. and requires no action by the purchasers.

Copies of Section 3 may be obtained on application to the above address, price 2s. per copy (post free).

Important: As all three Sections of No. RIC/131 have now been published, this Specification will in future be supplied by R.I.C. in its complete form instead of comprising only Sections 1 and 2 as heretofore.

The price of No. RIC/131 (Sections 1, 2, and 3 complete) is 5s. 6d. per copy (post free).

BACK NUMBERS OF "R. & E."

Back numbers are available from:—

Te Aro Book Depot, Courtenay Pl., Wellington.
S.O.S. Radio, Ltd., 283 Queen Street, Auckland.
S.O.S. Radio, Ltd., 1 Ward Street, Hamilton.
Tricity House, 209 Manchester St., Christchurch.
Ken's Newsagency, 133-135 Stuart St., Dunedin.

The 1951

Digest

OF

Circuits

PRICE 3/6

Available from Booksellers and Radio Dealers or from

"RADIO & ELECTRONICS"

P.O. BOX 8022 :: :: WELLINGTON

An Electronic Governor

(Continued from Page 15.)

of 10,000 hours (about 14 months of steady operation). All other electronic components are equally reliable. In case of failure, with attendant loss of output signal to the solenoid cup valve, a protective circuit returns the generator to the no-load, three-quarter speed condition, preventing a runaway.

Tube Data

(Continued from Page 34.)

operated under conditions not exceeding the recommended limiting values given under Maximum Ratings for this class of service.

In relay service, the 884 and 885 may be used to handle frequencies up to 15,000 cycles per second because of the short deionization time for these types.

Some Points About Long-playing Records

(Continued from Page 14.)

increased perfection in the reproducing equipment as well, so that there will be work to do if the best possible results are to be had from them. However, if we know audio enthusiasts, this will be the spur to further endeavour in the building of amplifiers, equalizers, dividing networks, and all the other paraphernalia of high-quality sound reproduction, and it is hoped that this journal will be able to assist in these new problems as it may have done in the past.

Wellington Radio Traders'

(Continued from Page 28.)

conditions will endure for a reasonable period of time. It is encouraging to know that in a period of relatively good trading, our Association is strong so that should problems confront us a little later on, our Association is in good trim to meet them.

Trade-in Handbook

This is enclosed for the benefit of members and should be a useful guide in many respects regarding trade-ins. It is a credit to the members of the New Zealand Federation who gave up their time for its production.

General

February 11th, 1952, has been tentatively fixed as the date for an evening meeting and function. It is hoped the evening will be interesting and perhaps, in a general way, offer something of an instructive nature to members. The Committee is now giving this matter consideration and a further advice will reach you late in January.

Personally, and on behalf of the Executive, I would like to thank all those members who have assisted during the past year in the running of the Association, not forgetting our Secretary, whose services have been readily available and whose good work does much to ensure the smooth operation of our organization.

W. L. YOUNG, President.

Distortion of Scope Traces

(Continued from Page 5.)

but this merely shifts the plane in which displacement of the electron beam occurs. The best remedy is increasing the distance between the 'scope and the device creating the field. Grounding has no effect.

BINDERS FOR "R. & E."

These are available to hold 12 issues—price 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.), Ltd., P.O. Box 8022, Wellington.

A New Radio Magazine "RADIO-GEN"

"Radio-Gen" is a new monthly paper devoted exclusively to the interests of radio and audio hobbyists. Included in the first issue will be DX notes written by an expert, circuits to build, articles of general and topical interest, and the first instalment of a serial feature "Audio from A to Z."

"Radio-Gen" is designed especially for the newcomer to radio, and the hobbyist who does not need or want advanecd theory in his radio reading.

The First Issue

Will be distributed in late February, price 9d. per copy. Ask your local radio dealer to procure it for you each month direct from Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

THE 1951 "R. & E." DIGEST OF CIRCUITS

A feast for the constructor. Contains a large selection of circuits which have appeared in "R. & E." over a period of approximately two years. Price 3s. 6d.

Available from booksellers and radio stores or direct from Radio and Electronics.

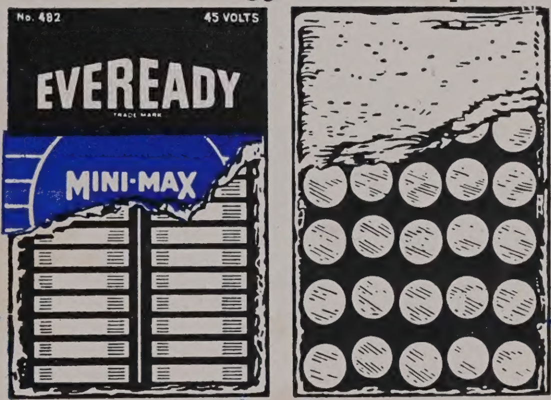
EVEREADY

TRADE-MARKS

MINI-MAX

"B" BATTERIES *have no equals!*

Here's how 'EVEREADY' 'MINI-MAX' 'B' batteries provide more energy in less space.



"EVEREADY" "MINI-MAX" Brand Batteries are tightly packed with active materials—more energy in compact, flat cells. "EVEREADY" "MINI-MAX" Radio Batteries made to equip every type of portable radio, gives users better listening—longer.

Ordinary portable batteries contain pitch, cardboard, and air—non-productive waste space between bulky round cells. The flat cells in "EVEREADY" "MINI-MAX" Brand Radio Batteries eliminate this waste space by giving the battery more power-producing materials . . . longer life!

EVEREADY

TRADE-MARKS

MINI-MAX

PORTABLE RADIO BATTERIES

A NATIONAL CARBON *Product*

OUTLAST and — OUTSELL ALL OTHER BRANDS!

The trade-marks "EVEREADY" and "MINI-MAX" distinguish products of National Carbon Pty. Ltd. (Inc. in N.S.W.)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TERMINALS
FUSEHOLDERS
UNITORS
NOISE SUPPRESSORS
Belling-Lee
COMPONENTS
RADIO AND
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AND SOCKETS
COAXIAL PLUGS
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